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[OFFICIAL NOTICE.]

Respecting the Official Work of the American Gas Light Association.

AMERICAN GAS LIGHT ASSOCIATION,
SECRETARY'S OFFICE,
530 Broadway, N. Y., Dec. 13, 1904.

To the Members American Gas Light Association: As there seems to be some misunderstanding respecting the standing of the official management of the Association, members will please note that the undersigned is the Secretary of the Association, and that Mr. A. E. Forstall is carrying forward the work of the Practical Class. All correspondence in connection with the Practical Class should therefore be addressed to Mr. A. E. Forstall, 58 William street, and all other matter pertaining to the Association to MR. GEORGE G. RAMSDELL, Secretary, at the above address.

[Special Editorial Correspondence.]

TWENTY-FIRST ANNUAL MEETING, OHIO GAS LIGHT ASSOCIATION.

HOTEL SCHENLEY, PITTSBURGH, PA.,
Wednesday, March 15th.

Dear JOURNAL: The first day's sessions of the coming-of-age meeting of the Ohio Gas Light Association have just been brought to a successful close. President F. W. Stone, Secretary T. C. Jones and the local committees, and the members and guests present are all agreed in saying, "It was great." Hotel, meeting room, weather conditions, attendance, technical work and a royal fraternal feeling were all that the most enthusiastic adherent of the Association could predict or expect. The Smoky City is not always noted for the beauty of its weather states in mid-March, but there can be no doubting that the weather man was all on the side of the gas man to-day. The Hotel Schenley and its assembly hall furnish ideal accommodations for such sessions. Away from the busy streets of the city the usual distracting external hubbubs that are a great interruption to the reading of papers and discussions were not at all. Two hundred and fifty members greeted President Stone at the opening. The programme as outlined was faithfully carried out, and that the officers and members were in good business form is shown by this brief recital or summary of the work that was done to-day. First came the call to order by President Stone and a hearty address of welcome by Pittsburgh's clever Mayor, the Hon. W. B. Hays, and a neat and witty response thereto by Mr. John D. McIlhenny. Then came the reports of the Executive Committee and the annual statements of Secretary-Treasurer Jones. President Stone's inaugural address (and a common sense, instructive document it was) was followed by the presenting of the Wrinkle Department, the contents of which was read by Mr. W. E. Steinwedell, owing to the unavoidable absence of the Editor, Mr. E. E. Eysenbach. The message from Editor D. W. Low of the Bureau of Forms and Records, as well that from the Information Bureau, under the charge of Editor H. L. Olds, a dip in Editor Henry L. Doherty's Question Box, the story of the

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SMITHSONIAN DEPOSIT.

Progress Department, as told by Editor Irvin Butterworth, the Report of the Committee on Flow of Gas in Pipes (Messrs. J. D. Shattuck, H. A. Carpenter and J. O. Johnston), with the paper on "Power Production from Gaseous Fuel," by Mr. J. R. Bibbins, is a list long enough to bear me out in the contention that from the technical side the day was a busy one. The reports of the Secretary and Treasurer are vouchers to the safe standing of the Association. New members to the number of 340 were placed on the rolls. This amazing addition exceeds anything ever obtained in any other Gas Association. Next year we may expect to see the Ohio come forward with 400 more new members.

The local Entertainment Committee have not been lagging in their duties. They have provided a fine entertainment for all who are here with us. To-night a smoker and vaudeville gathering is to be given for the gentlemen. I understand this function is to exceed any other ever given to the gas fraternity. The ladies are to be taken in automobiles to see the parks and shops and general points of interest in the city. What is dearer to a woman's thought than a shopping tour in an "auto.?" The ladies are to be entertained at lunch to-morrow by Mr. Heinze, the man of "57 varieties," and in the evening all visiting members are to be entertained at the Alvin Theater. Nothing has been left undone. Every item of business was brought out in a spirited manner. The Wrinkle Department was a distinct feature, for it certainly is colossal. The following resolution was unanimously adopted at the morning session to-day, the mover being Mr. Donald McDonald, of Louisville: "Mr. President, I move that the Committee on Place of Next Meeting be instructed to defer their report until after the meeting of the Western Gas Association, with a view, if agreeable to that Association, of arranging for a meeting next spring at the same identical point and the same identical time as that of the Western Gas Association, with the object that a joint meeting may result in a permanent organic union—not a federation, but a union, one and inseparable." This resolution was unanimously adopted with cheers and it shows that the Ohio, though the largest Association of the time, sees the necessity and demand of the hour for an Association of Gas Engineers which shall take its proper place among the technical Associations of America.

The Ohio Gas Light Association has forged to the fore by hard and intelligent work. Of course, credit is due to his co-workers, but Thomas Clive Jones has performed the major work and deserves unlimited credit for the same. We are going to the smoker and anticipate a fine evening, a report of which will come later.—F.

PITTSBURGH, March 16th, 1905.

Dear JOURNAL: What can one say that would rightly describe the "Smoker." Mr. Charles Bloomingdale, Jr., the Chairman of this branch of the Committee, succeeded in getting a great "bunch" of artists together. The entertainment was diversified and clean throughout. "Agostin" had some card tricks that even surprised some of our Western boys. The 30 ladies started on time for the automobile ride. They lunched at "Heinze's," and "shopped" in anybody's store. The programme for the day was being carried out faithfully. The papers were unusually good, as will be admitted by all after they have been read in regular publication. About 50 belated members came in this morning, bringing the attendance up to high water mark. The election of officers resulted in the following selections:

President—Mr. Donald McDonald, Louisville, Ky.
Vice-President—Mr. B. W. Perkins, South Bend, Ind.
Secretary and Treasurer—Mr. T. C. Jones, Delaware, O.
Editor Novelty Advertising and New Business Methods Department—Mr. George Williams, Madison, Wis.
Editor Wrinkle Department—Mr. William E. Steinwedell, Cleveland, O.
Members Executive Committee—Messrs. J. D. Shattuck and Henry I. Lea.

The business programme will be finished early tomorrow morning, after which will come the visits to the various iron works in and about Pittsburgh, and other suitable entertainment. I will not be able to send anything to-morrow (Friday) as I know that your first forms are off at 10 A.M. A resolution was adopted to appoint a committee of three to consider the advisability of changing the name of the Association, as the Association had become National in its character. The Committee at the time of writing had not been named. I regret to say that Secretary Jones was seized early this morning with a severe attack of pleurisy, but is now resting fairly well, and willing hands and alert minds are carrying on his work. The meeting has been a thoroughly successful one from whatever point of view its results may be pictured. —P.

[CONTINUED FROM PAGE 410.]

ABSTRACT OF PROCEEDINGS, FOURTH ANNUAL MEETING, WISCONSIN GAS ASSOCIATION.

HELD IN THE HOTEL PFISTER, MILWAUKEE, WIS., FEB. 15 AND 16, 1905.

FIRST DAY, AFTERNOON SESSION.

The President introduced Dr. H. B. Harrop, who read the following paper on

A BRIEF OUTLINE OF GAS WORKS' CHEMISTRY.

In "Part I." of this paper, covering the manufacture of coal gas, presented at last year's meeting of the Wisconsin Gas Association, I stated that the theory of the bench furnace had been developed at some length, and that while it had finally been stricken out to keep the length of the installment within reasonable limits, it would be given this year. In accordance with that promise I shall present here, before taking up the subject proper of residuals, some extracts from the discussion that will convey at least a fair idea of what goes on in a furnace when it is rightly and wrongly operated.

The free-fire or direct firing furnace, as applied to boilers and as was formerly—and is to-day to some extent—applied to retort benches, burns a solid fuel like bituminous coal, coke, or coke saturated with tar, in a current of air either "drawn" through the fuel and setting by the aid of the draft of a chimney or "forced" through by means of a fan or other mechanical blower. In the case of soft coal, containing a large percentage of volatile combustible matter, volumes of gases—hydrogen, hydrocarbons and carbon monoxide—are evolved, in part by distillation due to the high temperature and in part by what is called the "producer reaction." These gases, instead of burning immediately within or at the upper surface of the fuel bed, escape unburned for some distance away, and since an excess of air is supplied they burn as they mix with this air and give the phenomenon called "flame."

To get a complete combustion of the gases it is necessary to supply a wastefully great excess of air, a quantity as indicated by analysis of the chimney gas amounting to 50 per cent., 100 per cent., or often 150 per cent. greater than the supply theoretically required to combine with and completely oxidize to CO_2 and H_2O the fuel stoked into the furnace.

The more modern practice of "indirect firing" now generally applied to retort benches is based on the producer reaction. Carbon burning with adequate supply of air forms carbon dioxide (also called carbonic anhydride and too often carbonic acid) represented by the symbols CO_2. Carbon dioxide is the ultimate product of burned carbon, a compound which cannot be further oxidized, and in the formation of which the greatest possible amount of heat has been generated from the carbon. But if carbon burns with an insufficient supply of air, all of it that is oxidized cannot take the form of carbon dioxide, and a part at least of the gaseous product will be a compound called carbon monoxide; this latter gas is represented by the symbols CO, which indicate that only half as much oxygen has been taken up in its formation as has been taken up when the oxidation has been complete. Just as might be reasoned by any intelligent man, even though he knew nothing of the thermo chemistry concerned, this semi-oxidation has not generated all the heat energy that it is possible to generate from carbon; and this half-stage product, CO, is a combustible gas capable of burning by absorbing a second equivalent of oxygen to form CO_2, and generating the rest of the expected heat as it burns. To repeat: Sufficient or excess $O_2 = CO_2$; just half the sufficient $O_2 = CO$; a supply of O_2 between these two limits gives a mixture of CO_2 and CO.

Coke contains roughly about 90 per cent. carbon, and it has been found that if a deep bed of incandescent coke, supported within tight walls, is supplied with air from below, the gas emerging from the top of the bed of fuel will contain practically no CO_2 but will be rich in CO. This combustible gas, mixed with the residual nitrogen of the air used, is producer gas.

Atmospheric air consists of about 1 part by volume of oxygen and 4 parts nitrogen. The nitrogen is inert, and passes through the different operations unaffected but still mixed with the products. All measurements reduced to standard temperature and pressure, one volume of oxygen burning carbon completely gives one volume of CO_2; but one volume of oxygen burning carbon to CO only, gives two volumes of CO.

$$C + O_2 \text{ (1 vol.)} = CO_2 \text{ (1 vol.)}$$
$$2C + O_2 \text{ (1 vol.)} = 2CO \text{ (2 vol.)}$$

Therefore, 5 volumes air give 5 volumes chimney gas.

$C + O_2$ (1 vol.) + $4N_2$ (4 vol.) = CO_2 (1 vol.) + $4N_2$ (4 vol.)

But 5 volumes air give 6 volumes producer gas.

$2C + O_2$ (1 vol.) + $4N_2$ (4 vol.) = 2CO (2 vol.) + $4N_2$ (4 vol.)

It is important to remember that when CO is present in a gas mixture it occupies twice the volume of the oxygen that formed it, or twice the volume of CO_2 that would have been present *if the second equivalent of carbon had not been taken up.* This has a marked effect on the percentage calculations, and when it is forgotten invalidates an otherwise good analysis if CO is present in measurable quantity. The diatomic gases like oxygen and hydrogen should always be written O_2 and H_2 when calculating volumes, and never simply O and H. If this rule is followed the equations will give the volumes correctly.

Producer gas is generated commercially by "drawing" or "forcing" air through incandescent fuel with regard for a few important precautions. The fuel must be highly incandescent, it should "lie close" or compactly, there must be no black spots or blowholes through it, and the depth of the bed should be considerable while the velocity of the air current should be so controlled in relation to the fuel depth as to give an adequate time contact. It is generally accepted that the air at the point where it enters the fuel gives rise to CO_2, which is reduced ($CO_2 + C = 2CO$) as it passes further through the incandescent fuel; and the importance of good and sufficient contact is evident, when as much CO with as little CO_2 as possible is the object sought.

Now this is all very elementary up to this point. With the introduction of water into the problem, the theory becomes more difficult to follow—so difficult in fact that, in spite of the simple discussion that is usually assumed to cover the process, it is doubtful if a really good grasp of the phenomena can be obtained until some chemical and physical data have been worked out that are not in existence to-day. It is customary to introduce steam along with the air that enters the fuel bed, either direct or by keeping a pool of water where it can evaporate and mix with the air. Since the hottest part of the fuel bed is found at the point where the air enters, some agent is necessary to prevent the ash from fusing into an indestructible mass. Water vapor in contact with the incandescent carbon suffers decomposition ($H_2O + C = CO + H_2$), generating carbon monoxide and free hydrogen. This step—known as "water gas reaction"—instead of evolving heat absorbs it, and instead of increasing the temperature, as the oxidation of carbon by free oxygen does, lowers the temperature. By maintaining a supply of water vapor along with the air, then, it is possible to prevent the overheating of the fuel bed, while at the same time the producer gas is altered in volume and composition by the CO and H_2. The use of water vapor is not confined to the producers of the retort bench, and it is generally true that the commercial producer gas of to-day is a mixture of straight producer gas and water gas.

It is necessary to add a very considerable amount of water vapor to prevent hard clinkers, but this proportion must be controlled or the fuel economy will suffer. The fire may be chilled by it, or water vapor may pass through undecomposed and, by reacting with the producer gas before it reaches the combustion chamber, oxide a part of the CO to CO_2. Positive statements are common that this cannot happen because CO_2 breaks up at high temperatures to combine with free hydrogen. The truth is that the "law of mass" enters into the process. But where reversible reactions like this are intimately confused with dissociation, a point on which little is definitely and certainly known, it is not safe to theorize too far. There is some discrepancy among the different authorities on the amount of heat evolved or absorbed in the phenomena of combustion. The following table will be found sufficiently close for the purpose in hand.

The heat of combustion of gases, in B.T.U. per cubic foot, measured at standard temperature and pressure:

	Gross.	Net.
Hydrogen	350	300
Carbon monoxide	350	350
Methane	1,050	950
Ethylene	1,600	1,500
Acetylene	1,500	1,450
Benzene	4,000	3,850

Taking a producer gas composed of—

CO	28 per cent.
H_2	12 "
CO_2	3 "
CH_4	1 "
N_2	56 "
	100

the net heat generated per foot will be—

350 × .28 = 98.0
300 × .12 = 36.0
950 × .01 = 9.5

143.5 B.T.U.

The products from one foot of the above producer gas, assuming combustion to take place with exact proportion of air, can be shown by resort to simple chemical equations to be—

CO_2	.32
H_2O	.13
N_2	1.39
	1.84 cubic feet.

and—

CO_2	.32 × .119	(weight 1 cubic foot)	= .038 pound.
H_2O	.13 × .048	" " "	= .006 "
N_2	1.39 × .074	" " "	= .103 "

In the work I have been doing for the Board of Revision of the Ohio Gas Light Association I have investigated the subject of specific heats of gases at high temperatures, and from the charts that will be published at the Pittsburgh convention next month the following values are taken:

Mean specific heat CO_2 between 2,800° and 3,000° F. = .37
" " H_2O " 2,800° and 3,000° F. = .84
" " N_2 " 2,800° and 3,000° F. = .31

Then,

.37 × .038 = .014
.84 × .006 = .005
.31 × .103 = .032

.051

and

143.5 ÷ .051 = 2,814°.

for the theoretical flame temperature, without allowing for preheating, and assuming that no water has passed undecomposed through the fuel bed.

Far more important than calculation of flame temperatnre is the application of these methods to the waste gases. Taking the products to pass into the chimney at 1,000° F. (this is a matter readily and exactly determined with a pyrometer), we find from the charts:

Mean specific heat CO_2 at 1,000° F. = .27
" " H_2O at 1,000° F. = .65
" " N_2 at 1,000° F. = .26

Then,

.27 × .038 = .0103
.65 × .006 = .0039
.26 × .103 = .0268

Total.... 0.410

or .041 B.T.U. is the mean thermal capacity of the products from 1 cubic foot of producer gas, and the total heat above 0° F. contained in this waste product is (.041 × 1,000) = 41 B.T.U. The heat generated by the 1 cubic foot of producer gas is only 143.5 B.T.U., and thus, even on the assumption that there is no excess of air, the waste gas carries off 28.6 per cent. of it at this temperature, or more than one-fourth of every pound of coke burned.

Perhaps 90 out of the 100 members of this Association will wonder what practical good can come from a refinement of mathematics and chemistry of this kind. It is to be expected beforehand that someone will be moved to perpetuate the ancient query as to how a man can waste valuable time in such speculation, with the added suggestion that maybe his time is not valuable. I do not want to be misunderstood in this. To the superintendent of the average works this must have more of an academic interest than a practical value; but if the gas industry has a future before it, and if the production of gas is to go on in the larger centers of population on an increasing scale, gas companies will find themselves forced to put well paid, educated men into their retort houses who will have as their sole duty the perpetual adjustment of the combustion, and it is by such methods as these just touched upon that they will earn their salaries.

RESIDUALS.—*Coke.*—The three chief residuals of the gas industry are coke, tar and ammonia. Under average conditions the market price of the coke produced from a ton of coal is about 4 times that of the sum of the tar and ammonia produced at the same time. The manner of its production is governed almost entirely by the standard process of gas making, and very little latitude is allowed in varying the process to modify the character of the product to suit the wants of the consumer. In the coke oven system the carbonizing period is prolonged to give a

hard coke with minimum sulphur content, and a semi-bituminous coal having a low gas yield is sometimes purposely mixed with a regular gas coal to make the exact coke wanted. But in the retort system, where the gas is the prime consideration, no such control is allowable. Cannel, sometimes used for enrichment, gives a residue of little value, and even when mixed with gas coal it does the coke no good, but is tolerated for the sake of the candle power. The several effects on the coke of different circumstances of heats and carbonizing periods and of size and quality of coal used may be known, but the knowledge can be of little worth, in the nature of things, in producing the best coke. The chemistry of coke is a really wide field, but its practical application to the management of the works may be covered in a few items.

The best Pittsburgh gas coal obtainable to-day produces about 35 per cent. volatile matter and 65 per cent. coke residue when a small powdered sample is heated in a platinum crucible over a Bunsen burner, as prescribed in the first part of this paper read at last year's meeting. The volatile matter driven (consisting partly of matter that we are almost justified in regarding as having been evolved from a state of solid solution in the coal and partly of gaseous matter produced by the cracking of non-volatile substances that leave behind free carbon), will vary in amount and composition according as it is more largely produced by the "evolution" process or by violent "cracking," and is thus ultimately dependent on the way the heat is applied. Just as it is possible to produce different percentages of volatile matter from a given sample of coal through different arrangements of the coal and the flame, so we find that the carbonization of coal in the retort house seldom results in a yield of coke in close agreement with the laboratory test. It is very often true that the coal employed is not a 35 per cent. volatile matter coal, but this is only one of the reasons that the coke yield is more often over than under 70 per cent. of the coal carbonized. When the incandescent coke is drawn from the retorts and is quenched or cooled by the application of water from a hose or bucket, or by a water spray through which it is drawn on a conveyor, it proves impossible to adjust the water to the exact point that will quench the coke without leaving a surplus. This moisture may be partly given up to the air when piled in the open, or the rain or snow may add to it. The percentage contained at the time it is sold to the consumer (if, as is usually the case, the coke is sold by weight) is bound to increase the apparent yield, since the yield is based on the stock and deliveries. But another and more important consequence of the moisture content is the effect it has on the usefulness of a ton of coke to the consumer; for the constant up-hill fight to keep up the coke sales in competition with anthracite and in the face of popular prejudice ought not to be further hampered by unwittingly producing an actually inferior value.

The percentage of moisture in coke may readily and accurately be found by weighing about 500 gm., or 1 pound, from a freshly taken average sample and drying in a water oven on top of a steam radiator, or even on the back of a stove, and reweighing to find the loss. No particular precautions need be taken to keep the temperature low or at a fixed point as in the case of coal. If a water oven is used, a slow operation may be converted into a very speedy one by blowing a gentle current of air over the coke to carry off the water saturated air continually. The moisture may be recorded as per cent. of lhe wet fuel:

$$\text{Loss/wet coke} = \text{per cent. moisture,}$$

or, as amount of moisture held by dry fuel (per cent. on basis of dry coke):

$$\text{Loss/ (wet coke} - \text{loss)} = \text{per cent. moisture.}$$

With screened coke the moisture will generally vary inversely as the size, the breeze and dust containing the most. The first weighing should be made immediately after sampling, as the contained water escapes rapidly in a dry, warm place, especially when the coke is spread out in a thin layer. When fine results are wanted the dried coke should be weighed immediately after removing from the heating apparatus, as it will absorb moisture from the air on standing.

The ash determination is identical with that given last year for coal. The crucible should be tipped well over on its side on a triangle support, with the lid fixed in it at an angle to guide a draft of heated air into it. A Bunsen burner should be adjusted to keep the crucible at a bright red, and it should stand rather to the rear than the front of the crucible where the flame might prevent the ready flow of fresh air. An ash from which all the carbon has been burned presents an unmistakable appearance when stirred with a platinum wire and should not give rise to a "gritty" feel or sound. In both the moisture and ash tests it is safest to work to constant weight. That is, after the operator thinks the drying or combustion has gone far enough he takes the weight, applies the heat again for a time, and weighs once more; if the two weighings agree the work is finished, but if a further loss is observed the process is repeated until no further loss occurs. This repetition becomes unnecessary after the operator has made a few determinations and familiarized himself with the demands of the test.

The ash from breeze usually has not the clean, smooth appearance in the crucible shown by ash from the large sizes of coke, due to the presence of incombustible impurities that have been mixed mechanically with the fuel. For the same and other reasons the ash content of breeze is high, sometimes reaching 12 per cent. from a good Pittsburgh gas coal. Among the larger sizes, the ash decreases slightly as the size increases, though there is not much choice.

The volatile matter in coke is sometimes though rarely determined at the gas works. I have found the most uniform results to come from a special method in which the crucible is surrounded with a Chaddock ring and heated with a blast lamp for a definite time, say 6 minutes, the powdered coke being covered with a layer of powdered quartz to prevent access of air and consequent loss of carbon. A quantity of this quartz may be ignited and then stored in a tightly stoppered bottle ready for use at any time.

The percentage of sulphur in coke is determined exactly as in coal, and any one of the old crucible methods, like the Nakamura or the Eschka, may be used, or the cartridge method previously described. Coke lends itself to combustion in an open dish by sodium peroxide even more readily than coal. Hornby gives a 2 stage method wherein the coke is burned in a current of air which is drawn through a suitable absorbent and estimated by titration; this gives the so-called volatile sulphur in the coke. The ash is then fused with alkaline carbonates to determine the "non-volatile" sulphur.

It is occasionally required to analyze the ash to explain clinker troubles in the benches or water gas machines, or perhaps for a prospective customer who has got coke in view for some industrial purpose. This analysis is similar to clay analysis, which can be found described in almost any text book. More frequently the amount of iron oxide only in the ash is wanted; the standard potassium di-chromate method, which heats the ash with hydrochloric acid, reduces with stannous chloride, and estimates by titration, is suitable. Determination of nitrogen in coke, for which a modification of the Kjeldahl process is used, is rarely undertaken except as a matter of research.

The heating power of coke usually expressed in British thermal units per pound, may be determined easily and quickly with the Parr calorimeter according to the identical procedure previously given for coal. The instructions sent out with the calorimeter recommend a more elaborate process than for coal, but I have never found a gas coke that required any additional precautions. The heating value of sized coke is very much alike all the way through, with a trifle in favor of the largest lumps. Breeze, however, is markedly lower, and that from good Pittsburgh coal may run as low as 11,500 B.T.U. per pound dry. When wet breeze is used for boiler firing this low calorific power and the moisture contained should be taken into account before condemning the evaporative service of a plant. A ton of clean, dry coke ought to generate at least 25,000,000 B.T.U. The ordinary anthracite sold for domestic consumption will not yield a unit over 26,000,000.

Coal Tar.—From the chemist's viewpoint the tar and ammonia residuals are equally interesting; but the chemical tests for tar that are required in the average gas works to-day are few indeed. Let us glance at the uses that are found for coal tar, and then briefly mention a few points of importance in re-working and handling it.

The simplest uses of tar, and those which require the least amount of re-working, are based on its application in the raw state. Perhaps the oldest is to gas making; that is to say, the tar which condenses from the gas is returned to it again to some extent. Regarding tar as a distinct loss to the gas account, a number of attempts have been made to accomplish this in one way or another, and great claims have been made for some of the methods, but the proposal has few attractions. The result must be attained, either by driving out by heat the volatile illuminants dissolved in the tar, which it is hoped will remain suspended in the gas, or else by subjecting the tar to a temperature high enough to crack its constituents. Owing to the high heats carried in America our tars contain little volatile illuminant matter, and the bituminous bodies which make up a large percentage of the tar do not lend themselves readily to cracking into valuable gases.

Raw tar has found many applications owing to its qualities of fluidity, insolubility in water, drying power, and permanence in the air, and has been and is used for paving, roofing, coating wood and metal building structures and the like. Certain antiseptic preparations have been made from it, it is sometimes a source of lampblack, it is occasionally used as a lubricant, and there are many industries turning

out products that are first moulded in a plastic state and afterwards, in use, subjected to high temperatures, which utilize tar as a step in the manufacture. Specifically, tar is used to saturate felt and paper for roofing and other purposes, as an adulterant for pine tar and paints, and in numerous other ways unnecessary to mention.

Tar has a certain value based on its heating power in comparison to coke at a certain price. Aside from considerations based on the steaming power of a given quantity of tar it has the disadvantages that follow the use of any fuel giving a specially hot flame. The method of burning tar mixed with breeze, the simplest scheme, is a nuisance. Burned as a spray in a steam-jet, the fuel is not so extremely filthy, but the other disadvantages remain.

Gas companies operating a tar plant generally find that the plant foreman has a good many unofficial prescriptions for preparations that are not distinctly distillation products. Refined tars are sold which are simply raw tar with more or less of the volatile constituents driven off by heat; there are paints and varnishes made of mixtures of tars and oils, or of cut-back pitches; sometimes there are special tars prepared for peculiar purposes and declared to have imaginary virtues, like "net tar," a product saturated with alkali and sold as far west as the Columbia river for preserving fishing nets; a variety of emulsifiable disinfectants generally completes the list, unless the foreman is ambitious enough to try to turn out naphthaline.

A gas company distilling for pitch is usually guided by the business sense of the salesman and the demands of the market to the best earnings, so far as the non-volatile part of the tar is concerned. There is a market for pitch among the manufacturers of electric light and other carbon, and a hard grade known as target-pitch commands a high price; but a concern that tries to make the latter without a full knowledge and complete facilities will never try it again. Pitch offers some points of advantage over raw tar for service protection. In America it is customary, at least among gas works tar plants, to separate and sell only two fractions of oils; the stream of distillate is watched and when a sample taken from it is finally found to sink in water the so-called light oil tank is closed and the stream is then turned into the heavy or dead oil tank.

Of course, the oil in the light oil tank has a specific gravity of less than 1, but a good many of the constituents are heavier than water; on the other hand, while the heavy oil has a specific gravity of considerably over 1, it contains a certain percentage of constituents lighter than water. The separation is crude, but nothing better could be expected with the simple apparatus employed. Across the water it is common practice to produce at least two light oils and sometimes heavy oils, characterized respectively by their high content of carbolic acid, naphthaline and anthracene.

The light oil from American tars contains a small percentage of pure benzene; this and some of its homologues may be returned to the gas. A "purified benzol" (which I have found to be 20 per cent. gasoline) sells in the market at $1.50 per gallon, and chemically pure benzene commands 85 cents per pound in small quantities at wholesale. Toluene (not chemically pure), also present in the light oil, is worth 65 cents per pound. Light oil is used to some extent in gas company tar plants for cutting-back pitches to produce a number of so-called varnishes and is sold to manufacturers as a solvent. Both the oils have been a source of lampblack, and the heavy oil particularly has found uses as a lubricant. The production of pure naphthaline is not attractive. The heavy oil is sold as a timber preservative for a good price, and its virtue depends largely on the naphthaline contained. American tars are rich in anthracene, but its recovery has received little attention, as there is no market for it over here. The phenols and cresols (carbolic acid, etc.) can be recovered from the oils without great difficulty. The essential features of this recovery are agitation with alkali, and the subsequent decomposition of the salts formed by means of acid. Shingle stains and antiseptics are produced to a noticeable extent; the latter are usually made by adding to heavy oil a rosin-alkali mixture that renders the oil emulsifiable. A number of these are sold by manufacturing pharmacists under such names as creolin, creotar and cresolin at a round price.

The American oven concerns are manufacturing, or have in the recent past, secondary products like nitro-benzol and synthetic calycillic acid, and thousands of dyes, therapeutic complexes and chemical reagents are produced from coal tar in Europe, but the gas company tar plants can have no interest in anything of this kind.

The operation of the tar plant is almost invariably in the hands of the foreman in a fuller sense than any other department of a gas company gets to be. An American gas company usually cares little and knows less about its tar. The operation is almost purely rule-of thumb and such refinements as slowing the fire at certain points (indicated with much care in the books) are unknown; a hydrometer is never used; the plant is usually found to have been provided at some time in the distant past with degenerate instruments called pyrometers which seldom work, and at which the foreman never looks; the point where distillation is to be stopped is learned by experience, and since the oils are a minor consideration and the character of the pitch of great importance, it is this that the foreman watches, judging samples as a rule from time to time by chewing them between his teeth.

In running he has always two dangers to guard against—frothing or boiling over at first, and the formation of coke scale toward the latter end. To get the capacity out of his plant he must push it to the utmost. To hasten the operation and prevent coking, superheated steam or air is sometimes forced through the charge to keep it agitated, and mechanical stirrers are also used. Even if a coke scale that endangers the still shell is avoided, there is a tendency to charge the pitch with minute fragments of coke which are evident to the eye on drawing it out to a thread. After the distillation is completed further delay occurs, because the charge must be cooled to a point where it will not fire spontaneously when run into the air; and the hurry to get it barreled is further hampered by the reach of the vapors from hot pitch, carried far enough by a favorable wind to wring complaints from a neighborhood.

Crude tar always contains a quantity of water, and as this is largely responsible for frothing in the still the tar is first treated by heating moderately in a special tank for a day or two when the bulk of the water will have separated. One of the few tests commonly applied to tar is the determination of the amount of water it holds. This is made by adding a quantity of benzol and distilling in a laboratory still. A graduated receiver is used and the water is read off from the stratified column. A method I have devised, that is quicker and cleaner, consists in shaking 10 cc. tar in about 100 cc. gasoline, adding a number of pieces of metallic sodium (not less than ¼ inch in diameter and having no jagged edges or attached fragments), shaking at intervals for several minutes, and pouring through a strainer to remove unoxidized sodium. The strained solution is then mixed with an equal bulk of distilled water and titrated with normal H_2SO_4. The water originally present in cc. tar is calculated from

$$Na_2 \times H_2O = Na_2O + H_2 \text{ and}$$
$$Na_2O + H_2O + H_2SO_4 = Na_2SO_4 + 2H_2O.$$

The amount of free carbon in the tar is sometimes wanted. A common method is to shake a known quantity of tar with carbon disulphide and pour through a tarred filter, which is then washed with clean disulphide, dried and weighed. This is only approximate, as the residue is further slightly decreased by washing with benzene, boiling alcohol and other solvents. The test is also applicable to pitch. The heating power of tar and the sulphur content may readily be determined by the cartridge method used for coal and coke.

Ammonia—In treating of the ammonia residual a few passages will be repeated from last year's paper to give a connected discussion.

The nitrogen (N_2) of the coal produces free nitrogen, ammonia (NH_3) cyanogen (C_2N_2) and other nitrogenous bodies found in the coke, tar and gas.

Other things being equal the yield of ammonia has been shown conclusively to vary with the nitrogen contained in the coal. Foster, investigating English coals, found that the distribution of this original nitrogen ran as follows:

	Per Cent.
As ammonia	14.50
As cyanogen	1.56
Remaining in the coke	48.68
Free in gas and unaccounted-for	35.26
	100.00

The total nitrogen in this coal amounted to 1.73 per cent., hence if all of it could have been converted into ammonia the yield would have been 42.01 pounds ammonia to the American ton. Knublauch, examining coals of Westphalia, found this average distribution of nitrogen:

	Per Cent.
As ammonia	13.00
As cyanogen	1.80
Remaining in coke	32.80
In the tar	1.35
Free in gas and unaccounted-for	51.05
	100.00

Total nitrogen in coal, 1.51 per cent.; or a theoretical equivalent of 36.67 pounds ammonia per ton. In average American practice 5

pounds ammonia to the ton, or ¼ of 1 per cent. of the coal, is reckoned a good result; in some cases it runs a little higher, but 4 to 4½ pounds is more common. It has been claimed that medium heats are favorable to the greatest yield; however this may be, there can be no question that very high heats decrease the yield. Lunge quotes exhaustive experiments which prove that ammonia gas passed through a hot porcelain tube is decomposed, and the higher the temperature the more complete and rapid is the decomposition, and he points out that with red-hot coal it combines partly with carbon to form cyanogen, $2NH_3 + C = NH_4CN + H_2$.

The mixed ammonia liquor from the mains, condensers and scrubbers usually contains ammonium carbonate, ammonium sulphide, ammonia-cyanide, ammonium sulphate, ammonium chloride, ammonium sulphocyanide and ammonium ferrocyanide.

Several different carbonates and sulphides are recognized; there are minor compounds like sulphite, thiocarbonate and acetate, and uncombined ammonia may also be present. Besides these the liquor will contain phenols, benzenes, naphthaline and tarry matters. In the still some of these bodies come over with the concentrated liquor, and float on the liquor in the storage tank as a black oil. The carbonates, sulphides and cyanide are commonly called volatile ammonia compounds because they readily volatilize or dissociate to gases when the solution is heated. It is the cyanide chiefly that attacks the pipes and fittings, and the carbonate that forms the stoppages in the concentrator. The chloride (sal ammoniac) is classed as a non-volatile compound, but distils slowly from its solution in the boiling water.

To determine the ammonia in a sample, 10 cc. may be boiled in a flask with an excess of sodium or potassium hydroxide, and the volatilized products led through a tube into a condenser and then into a breaker of water containing a known quantity of normal sulphuric acid solution; by titrating the contents of the beaker with normal sodium carbonate solution, the amount of acid neutralized by ammonia is found and the ammonia calculated from this figure. The "free" or volatile ammonia is found by a similar operation, using a clean flask and no alkali; a simpler way of arriving at this is to dilute 10 cc. of liquor in a beaker, add a little methyl orange as an indicator, and run in normal acid until the saturation point is reached. The results are nearly identical.

The English system of rating ammonia liquor in terms of "ounce strength" is still in general use in this country. The words mean the number of ounces of real sulphuric acid (by weight) required to saturate the ammonia contained in one gallon of liquor. Crude gas liquor on the average is found to run from 4 to 10 "ounce," or roughly from 1 to 2 5 per cent. ammonia. When pipettes and burettes graduated in cubic centimeters are used in the readings they are converted into "ounce strength" by multiplying the number of cc. of normal acid necessary to neutralize 10 cc. of liquor by .6545. To find the number of pounds of real ammonia in a tank of liquor, take number of gallons-times' number of cc. of acid times', .6545 times .02168; or gallons times cc. times. 01419.

The total ammonia in a sample may be determined without flask or condenser by having a normal solution of sodium hydroxide. An excess of this (carefully measured) is added to the liquor sample in a beaker along with a quantity of water, the mixture being boiled for a few minutes, and then titrated with the normal acid; the difference between the alkali and acid used is calculated as fixed ammonia. This, added to the free ammonia found by direct titration, is the total.

A solution of uncombined ammonia gas in water has a specific gravity of less than 1; solutions of salts of ammonia are heavier than water. It should be evident, then, that the strength of liquors of unknown composition cannot be estimated with near accuracy by the Twaddel, Beaume or any other hydrometer.

The strengh of liquor may be reported as "ounce strength," or as pounds of true NH, per gallon, or as percentage by weight. The last, which has superseded the ounce strength notation to a very large extent, requires the specific gravity of the liquor to be known. Having found the specific gravity, conveniently with a hydrometer, the weight of a gallon of liquor is calculated from the weight of a gallon of water (8.33 pounds), and the weight of ammonia in the gallon having been determined by use of standard acid, the percentage is simple arithmetic. A few concerns give results in milligrams or grams of ammonia per liter; this may be converted into pounds per gallon, or the reverse, by taking 1 gallon equal to 3.785 liters and one gram equal to. 0022 pound.

In a works where the approximate strength of the concentrated liquor is wanted frequently it may be determined by direct titration on a 1 cc. sample, comparing with a standard test both by titration and distillation on liquor of the same general character, to allow for the fixed ammonia present. The ammonia present as fixed compounds is almost negligible and practically constant.

Crude liquor is concentrated either in an intermittent or a continuous still. The old-fashioned, intermittent arrangement is seldom used, but it is not at all unsuited to small works where the liquor made is limited, the first cost being small and the skilled attendance required trifling. It consists essentially of an old boiler; this is partly filled with the crude liquor and a quantity of lime added. Steam is applied to keep the charge hot and agitated, and the gases and water vapor given off are passed through cooling coils which condense out and return a part of the water. The partially dried gases are then cooled further, and ultimately go into solution in the remaining water after it has condensed to the liquid state, to form the concentrated liquor for shipment.

In the continuous concentrator the crude liquor passes downward through a series of seals, where it is boiled by an ascending column of steam and hot ammonia gases. The wet gases, passing through a device for preheating the crude liquor, go to the condensers as in the other type of apparatns. After being freed of the volatile ammonia compounds, the crude liquor enters a chamber into which milk of lime is fed continuously. The fixed ammonia compounds are broken up, and the exhausted liquor flows into the sewer. An improved form of such a concentrator is described by Mr. Unger, in the 1903 "Proceedings" of this Association. It may be seen, substantially as described, in operation at the West Side works of this Company, where it is regularly working at an efficiency of over 99.5 per cent.

In a continuous concentrator the volatile ammonia compounds are almost entirely driven from the liquor before the lime is added, and thus the amount of lime consumed is limited by the "fixed" compounds only. If a ton of coal yields 5 pounds NH_3, and 16 per cent. of the total ammonia in the liquor is fixed (a fair average), then, as CaO takes up the acid combined with $2NH_3$ (for example $(NH_4)_2SO_4 + CaO = CaSO_4 + 2NH_3 + H_2O$), 1.3 pounds of pure lime will be required theoretically per ton of coal carbonized. Commercial lime is not pure CaO, of course, and it rapidly absorbs moisture to form $Ca(OH)_2$, and besides this the amount used in practice will depend largely on the design of the concentrator and the skill of the operation, but with a careful operator and a first-class still I have found the calculated result attained almost exactly.

There is a prevailing notion that only freshly burned lime is suitable, but this is a mistake. Lime that has completely slaked will do the work equally well if a sufficient quantity is taken to allow for the absorbed water, and lime even that is partly carbonated gives fair results.

The waste water from the concentrator is examined from time to time by the operator. It is usually sufficient to smell the vapor arising from it to detect a trace of ammonia, providing there is a certainty that an excess of lime is being pumped in. A surer and more delicate test is made by catching a little of the hot water in a dipper and dropping in a clean lump of quicklime, trusting then either to the sense of smell or to moistened turmeric paper held in the steam. If the waste water is to be examined quantitatively, as much as 200 cc. may be taken for the distillation test; supposing the factors used for converting to ounce strength or pounds of ammonia are all based on 10 cc. samples, correction for this 200 cc. taken must be made by dividing by 20. The strength of the waste should never run as high as $\frac{1}{100}$ of the strength of the crude liquor operated on, and properly ought to run considerably less than $\frac{1}{1000}$.

It is hard to say just what the yield of ammonia should be under ideal conditions. Pittsburgh coal seems to give a sustained yield of 5 up to 5.5 pounds per net ton in a few exceptional gas works, but it would be safer to take 4.5 pounds as the average of fair practice, and many works do not reach that on a year's report. Exceptionally high heats have something to do with a poor showing, but as a rule the trouble is purely a question of mechanical losses; leaks in the retort house overflow seals, in the covers of tanks and wells, cracks in the walls of brick or concrete wells, caulked joints in steel tanks that have succumbed to corrosion, underground systems of blind, disused and porous liquor pipes, ammonia pumps whose stuffing boxes need packing, forgotten by-passes that hint of past attempts to use liquor and fresh water simultaneously on scrubbers or condensers, loose cocks, overflowing wells, and finally, vapor, liquor and waste losses from the concentrating plant are a few suggestions from actual observation in various plants. The production of aqua, anhydrous and purified salts of ammonia is a little industry in itself, and while one or another of these is manufactured on a small scale by a few gas companies, and it is possible that the future will see it become more general, they will not be treated at this time.

Anyone interested in a complete analysis of ammonia liquor can find Dyson's method, with comments, in Lunge's "Coal Tar and Ammonia" (reprinted in Hornby's "Gas Engineers' Laboratory Handbook"), and Dr. Arnold's brochure on ammonia also treats of this elusive subject.

Cyanogen and Minor Residuals.—The recovery of cyanogen has never presented very great attractions to American gas managers, chiefly for the reason that no good, simple process has ever been devised. At the present time there is an uncertainty as to the future of the cyanides market, owing to the existence of some partially developed schemes for producing cyanides synthetically from atmospheric nitrogen, and this uncertainty will remain until it is known positively whether the gas works product can compete in point of cost. The chief hope for the recovery of cyanogen in the gas works lies in the fact that, added to the revenue from the residual, there would be sensible economy in avoiding the destruction of pipes, apparatus, meters and fittings. Taking the abundant production of cyanogen due to high heats carried in American retort houses, it is easy to figure on paper a gross revenue from cyanides of 50 cents for each ton of coal carbonized, or rather more than the gross revenue from the ammonia produced at the same time; but when the necessary plant and skilled control are considered the net profit fades away, and until the ideal process is evolved practical men are not likely to give this subject much attention.

I have made a very thorough study of the history of the problem and should like to sketch the progress made, but it is entirely outside the scope of this paper. The work of Gauthier, of Bouchard, of the German chemists who practiced recovery from the Laming mixture, of Knublauch, and of Gasch and his precipitated sulphide, accomplished practically nothing. The "Amsterdam" process was displaced at The Hague recently by Ruttern's process, which is said to work, although the plant required is considerable. The inventor's statement that he produces insoluble ammonium ferrocyanide is untenable, as this salt is very soluble. The insoluble salt actually formed may be ferrous ammonium ferrocyanide, corresponding to the potassium salt "Everitt's white." The Bueb process is widely used in Germany and is generally considered the best yet devised. The Schroeder process, the American patent of which was taken out about 5 years ago, employs ferrous chloride ($FeCl_2$)! The British Cyanides Company's process, instead of aiming to manufacture ferrocyanide of iron or potash, as most of the methods do, produces ammonium sulphocyanide. All of these processes increase the amount of lime required to distill the ammonia liquor to a very high figure. I am of the opinion that the best method of recovering cyanogen from the products of coal carbonization—when it comes—will not produce a ferrocyanide or sulphocyanide, but will give us directly a simple cyanide of an alkali (KCN or NaCN.)

The spent oxide from the coal gas plant is sold to manufacturing chemists who extract the cyanides. Even in the face of the extremely low price obtained it can scarcely be argued that a gas company ought to attempt to work up the purifying material. The cyanogen is the sole item of value; the sulphur contained cannot be made to enter into competition with the natural product. A quantitative test for sulphur is usually made from time to time for the purpose of judging its condition as bearing both on the work expected from it and its suitability for shipment. The test commonly used depends on the solubility of free sulphur in carbon disulphide, and may be applied with the arrangement of percolator, flask, condenser and solvent trapped under water, given in the various English text books, or with a Soxhlet extractor. A very simple device, sometimes used in the Milwaukee laboratories, consists essentially of a small percolator and a stoppered flask with a glass tube passing through the cork stopper and bent to lead into the upper end of the percolator. The flask is partly filled with disulphide, and as it stands on a steam plate or water bath a continuous distillation and percolating process is set up. To allow egress of air at first, and afterwards to prevent loss of vapor, a 1-bulb thistle safety tube is inserted through a second hole in the cork stopper at the upper end of the percolator.

The ferrocyanide in oxide may be determined in several ways, none of which has much to recommend it, A simple method is to treat a sulphur-freed sample with sodium hydroxide, precipitate with iron the soluble ferrocyanide formed and ignite to ferric oxide. A volumetric modification exists.

If time and opportunity had offered, a few notes might have been presented on some minor residuals.

The discussion on the Harrop paper seems to have ended the first day's proceedings.

SECOND DAY, MORNING SESSION.

The President announced that the

ROLL CALL

was in order. The following responded to their names:

Active.

Brown, R. B.	Humphrey, H. M.	Pratt, E. G.
Buck, H. M.	Johnson, W. B.	Richards, F. M.
Cornish, R. C.	Kraft, R. P.	Rockwell, G. A.
Cutcheon, M. H.	Leuenberger, W. A.	Russell, J. K.
Daniell, E.	Linstedt, J.	Rutledge, T. J.
Gelatt, P. M.	Lloyd, A. G.	Schaeffer, J. W.
Haase, E.	Lawrence, B. A.	Schaper, H. C.
Hendley, J. S.	McAdam, B.	Unger, J. S.
Hendley, T. C.	McKay, C.	Viles, B. D.
Hyde, H. H.	Mainland, S.	Vits, H.
Harman, H.	Mason, J. T.	Walker, J. H.
Harrop, H. B.	Patten, J. A.	Wallen, W.

Associate.

Bredel, F.	Lindsay, C. R.	Schall, H D.
Franke, H. E.	Lovett, E. C.	Shirra, J. C.
Hennings, P. W.	Merkle, O.	Stratton, S. S.
Kellum, B. J.	Martin, E. B.	Wickham, L.
Kohen, J. A.	Rue, G. W.	Zwisler, A. L.

Mr. George Williams read the following paper on

PROMOTING NEW BUSINESS:

Under the conditions of the present average management any gas company should increase its business and earnings from year to year without investment in a so-called New Business Department to some extent, owing to the constant discovery of new uses for gas—new building, natural increase in population on lines of main and the higher standard of modern methods of living; in other words, the gas company is to a certain degree forced to keep pace with the times. From a commercial standpoint, then, the company is on the same plane as the leading general store in the country village, sure of a certain volume of business, but too often contented with that certain patronage, and sometimes very independent in treatment of customers.

Assuming the position of a company that sincerely desires to make a marked financial success, with little or no increase of capacity to double its revenues within a period of 2 years, the following conditions would be almost essential:

(1.) Optimistic management.
(2.) Harmonious conditions among employees of the company.
(3.) The good will of the public.
(4.) A uniform supply of good gas.
(5.) Direct and vigorous advertising, sale and maintenance of gas lamps and appliances.

The foregoing conditions are not impossible to attain, and will be found to exist in any gas company that has shown brilliant results. No gas company has as yet reached the limit of its possibilities, and when it has reached a predetermined standard in number of lamps or appliances, the possibilities have increased in such volume that the number of opportunities has grown faster than the company could have even gone or asked for them.

A company operating on methods common to any modern mercantile business must assume that it wants all the possible business, and must reach out for it all; while it is impossible to get it all, enough will be secured for brilliant results. In these busy times the company that is content will sooner or later become stagnated The success will not come from accident, or in 6 months, and the company has to be prepared to accept the success. Remarkably few companies get more than they reach for.

It is not unreasonable for a company to expect every family living on its mains to use gas exclusively for cooking purposes, some lighting and some heating, and to expect every business concern that could to advantage use gas for industrial purposes; yet should only half of these possibilities be reached, it would in most companies, produce net earnings several times greater than the present.

Should a company install every gas appliance within reason in every home, there would still be plenty of promotion work to do in raising the standard of lighting, and educating the consumer to further advantages of gas fuel.

Optimistic management demands the belief, anticipation and enthusiasm in the possibilities and ultimate success of the desired achievements.

Harmony between the management and the employees, between one department and another, and between every employee and the other. Weekly meetings are possibly the quickest and surest methods of bringing all to the comprehension of what the company is trying to accomplish. Harmony will establish loyalty and higher efficiency.

Good will of the public is an easy condition to attain where sufficient

number of company representatives are employed to take care of the company's interests, and their work backed up by every employee's ambition to further the company's welfare.

Courteous treatment over the telephone, in correspondence and every contact with consumer is possible and essential. Liberal daily newspaper advertising and all progressive and modern methods of advertising tend to incline the public to a friendly attitude toward the company. It does not take long for the public to credit the company for good intentions, if the intentions are sincere, and reaching out for more business is a very fair guarantee that the company is anxious to maintain present business satisfactory to the consumer.

Public desire for municipally owned gas property sprung from tendency of privately owned corporations abuse of privilege. A properly organized promotion department will withstand any competition. If gas companies existed in scriptural times, no doubt but that a text would be found to say: "If gas companies would have friends, they must be friendly."

A uniform supply of good gas is absolutely necessary, as the company bases many claims on the benefits of gas fuel for even, steady heat; besides this, a variation of supply in either pressure or quality creates a suspicion from the users that the company is either incapable or indifferent in supplying them.

Vigorous lamp and appliance promotion requires modern commercial methods of publicity, exhibition, explanation, drawing of prospective customers, attention and courtesy common to any line of retail business. This feature is too vital for a company to place outside the gas office. The sale of a stove signifies no profits unless followed by its use, hence the desirability of placing large stoves that provide for the entire stove needs of a household, and knowledge to the purchaser of its advantages. The sale of hot plates and cheap ranges for kitchen use should never be tolerated, and this condition lies entirely within the control of the gas company. Care and maintenance to give satisfactory service call for that work from the gas company, and if promptly and honestly performed lead to increased sales. No company exists that cannot increase its output and gather that class of business most profitable to it.

Hotbed methods to succeed demand expenditure, but the field is so great that almost any determined effort pays for itself. Many here will see the day when the merchant will cheerfully invest as much for illumination as for rent; the housewife will cook exclusively with gas, and every manufacturer who uses fire at all a liberal daylight consumption. As long as new households are formed and new houses built will there be a demand for *more light* and *more fuel*.

Every reputable national magazine and newspaper will teach the benefits of gas as fuel, and every show window will be illuminated until midnight every night.

The gas manager's life is too short and time too valuable to trifle with half-hearted or obsolete methods. Enthusiasm and determination will mark the pace of the station meter and the price of his company's stock.

Mr. B. C. Adams read the following paper on

FUEL ECONOMY:

Much has been said regarding the relative heating value of coals. The calorific value has been figured from a chemical analysis of the coal, and compared to the value as determined from calorimeter tests. The tests have not checked by small percentages. It has been said that the calorimeter probably gave results more nearly equal to results obtained in practice. This is likely true, but in any event it is an approximation.

If a chemical labratory is maintained, and it is an easy matter to arrive at a correct analysis of the coal, it is well to systematically test it. In most cases it is more convenient, and results just as satisfactorily, to watch the coal cars very carefully as they come in, making a thorough examination of every one. Perhaps a certain grade of coal is being contracted for. Suddenly an increase in fuel consumption occurs. The station meters are ordered tested, the stokers and furnace men watched, and finally the coal is examined. No doubt it is found full of dirt, slag and slate. The demand for good coal such as has been purchased having been so great that some consumers have been slighted and a substitute grade of coal sent them, the fireman's inexperience with the poorer grade of coal aids materially in the reduction of economy, and it frequently happens that the percentage decrease in economy is even greater than the percentage decrease of heat units per pound of coal. This can be attributed to the fact that there is a certain grade and kind of coal which can be most advantageously burned in a given boiler, due to the construction of the grates, etc. When a coal not adapted to the conditions is used, it follows that it must be burned at a disadvantage, causing a loss in efficiency, Firing with any coal, the following points should be observed:

A. Put the coal on evenly, and have no holes in the bed to let air through, as this will prevent complete combustion and cool the combustion chamber disastrously.

B. Take care to keep fire on the back of the grate. This is often neglected.

C. Fire the coal through the different doors in rotation and clean in the same manner. When cleaning, the fire should be pushed back, the grate cleaned and the fire pulled forward again. It happens frequently that the fresh coal is put onto the grate and the fire pulled over it. The coal then drops through the bars, while the cold air, coming in contact with the coal first, prevents satisfactory combustion from taking place.

In regulating the draft a number of things come into consideration. The capacity at which the boiler is being driven, together with the quality and kind of fuel, primarily determines the most economical depth of fuel bed, providing other conditions are such as desired. Then having established the depth of fuel bed at which the boiler can be fired often enough to maintain constant pressure, and still not lose economy by admitting too much air through the open fire doors, the primary air must be regulated to give best results.

When fresh coal is thrown onto the incandescent fuel bed, the hydrocarbons are liberated in large quantities, resulting in an absorption of heat and an improper mixing of air. The amount of air necessary for proper operation varies with the different stages of the combustion of the coal, but it is better to regulate it for the amount needed after the heavier hydrocarbons have disappeared. It is then the best results can be obtained, and economy would be lost if the ventilation were not correct. Forced draft should be watched very carefully. Damage is liable to be done to the boiler, due to concentrating the heat in certain portions.

A test of the flue gases will show the amount of over or under-ventilation, as the case may be. A certain amount of over-ventilation is necessary, and the flue gas test is a check on the firemans judgment. The fireman can tell if he under-ventilates, for his fuel bed will become thick. It is more difficult for him to know when the amount of over-ventilation is excessive. To keep the pressure constant, he will open the ashpit doors as far as possible until the pressure starts up; then he will shut them almost tight. The flue gas test will aid him in correcting his error.

Firing a boiler for capacity often results in a loss in economy. The heating surface may be insufficient, although a high percentage of CO_2 is obtained, to take care of the total amount of heat available but still necessary to carry the load.

Different amounts of CO_2 are obtained in different boilers for the most economical firing. Boiler construction and fuel are responsible for this. Tests have been attempted to determine the relation of boiler efficiency to percentage of CO_2 in the flue gases, but as far as I can find nothing satisfactory or definite has been determined.

There are many chances for error in a flue gas test, brought about by oxidation of the sampling tube and changes in temperature, together with personal errors of the operator. Allowance must be made for such errors. Get the fireman to work on the analysis, interest him, and show him how simple the operation is; show him what the results mean. Co-operation on his part must be had in order to make any increase in economy lasting.

There are other things besides firing which affect the economy of a boiler. Examine the setting for cracks where air might leak in. See that the doors all fit tightly, allowing no air to get in and spoil the draft. The fireman should not allow steam formed by wetting down his ashes to enter the combustion chamber through the doors, as heat is thereby absorbed and the temperature lowered.

In firing a bench keep the fuel leveled off and carry the bed deep enough to bring the surface near enough to the combustion chamber to obtain the best results. Local conditions should determine the heats. If you have no market for tar or coke it is perhaps better to carry heats to obtain the highest possible yield without burning the retorts or filling the pipes with lampblack. Watch the benches carefully for short circuits in primary or secondary air. Very small leaks make a large difference in the bench fuel and cubic feet of gas per pound of coal carbonized. Keep the flues clean from top to bottom. Use all pains to keep all holes filled with fireclay.

If by any work that can be done on the benches the yield can be brought from 4½ to 5 cubic feet per pound of coal carbonized without an increase of bench fuel, a saving of 11 per cent. has been made. At a consumption of 25 tons a day in the retorts, at a cost of $5 a ton, or a

total of $125 a day, the output has been increased 11 per cent, or the fuel expense decreased 11 per cent. This amounts to $13.87 per day, or $5,062.55 per year. Some of the steam piping around a gas works can be made to save money by a few changes.

The piping should not be too large for its purpose, as it then affords an unnecessary amount of condensing surface. As many turns as possible should be avoided, and long radius bends put in where feasible. Pipe covering of good quality can be used to advantage, and where pipe is used constantly it should be insisted upon. It is poor practice to run pipe underground where an overhead construction can be used. No matter how well put in, pipe underground is sure to leak in time, and and in many cases to come in contact with water, causing a large loss from condensation and loss of heat. Steam pipes can be run overhead covered with a layer of good asbestos covering, and this protected by a weatherproof covering, similar to roofing, when run outdoors. All pipes should be arranged to drain properly. Leaky valves on pipe lines should not be tolerated. It is not an easy matter to find leaks in the steam piping about a gas works where it is dark and noisy. Follow the pipe carefully and the leaks can be located. A very small leak does not amount to much, but remember that the small leaks add up the same as pennies, and pennies make the dollars—dollar, times 365 days in the year mean something.

Make it someone's business to see that all steam pipes, valves and pumps are kept in repair. After having made a thorough examination of boilers, benches, steam piping and auxiliaries using steam, have everything put in repair, and then make every effort to have it kept there.

[To be Continued.]

[Official Report.—Revised by the Secretary.—Continued from Page 407.]

THE THIRTY-FIFTH ANNUAL MEETING OF THE NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.

Held in Young's Hotel, Boston, Mass., Feb. 15 and 16, 1905.

First Day—Afternoon Session.

QUESTION BOX.

The President—We will take up the specific answer to the question:

"How much water is used to quench a net ton of coke?"

Someone has a reason for that. Mr. Woodward, have you any record of the working in Pittsfield?

Mr. Woodward—I have not any figures in mind.

The President—Have you any idea?

Mr. Woodward—I have them at Pittsfield, but cannot recall them.

The President—Perhaps someone can answer that specifically.

Mr. Anderson—I think, Mr. President, I should want to know how the water was applied, whether the coke was spread out on the ground thin or in a heap, or whether the coke passed through a tank of water.

The President—There is a very great difference whether it is spread out in 1 minute or 5. Will someone tell what the average might be counted, if any records are kept? Mr. Norton, have you any figures?

Mr. Norton—No, sir.

The President—We will draw one more.

"What is the specific heat of coal tar?"

Has anyone any definite information or result of tests upon that? Perhaps Mr. Slade may answer.

Mr. Slade—I don't know, sir.

The President—Does anyone? Well, on the same line:

"Can we co-operate in the sale of our tar?"

Does anyone know if that is possible, and if so how and where? Mr. Lamson, where do you sell your tar, and how, if that is a fair question?

Mr. Lamson—I have sold it to the National Coal Tar Company.

The President—Will they take it?

Mr. Lamson—In the present year it is very difficult to know what to do with tar.

The President—How is the stock in Holyoke, Mr. Snow? Have you succeeded in disposing of tar, or do you have to store it.

Mr. Snow—We are storing it. We are overrun.

The President—There is a short topic indicated as "The Tar Situation." We hoped we might have had a paper written directly upon it, but it was not produced. Mr. Slade, have you any information or special figures on the question that you would and can give to the Association?

Mr. Slade—No, sir; I have not. I am practically a new-comer in this territory, and it would be rather presumptuous for me to step in with all these people and attempt to solve off-hand a problem that has occupied their attention for years.

The President—This is a nice way to get acquainted. Everyone can see your face.

Mr. Slade—The whole trouble with the tar situation, I guess, is that there is too much tar and not enough demand for it. I have investigated a little bit the prices obtained by the so-called "combine," and the difference between what they pay the gas companies and what they receive I think is a perfectly legitimate one. The market seems demoralized. As to the question of distilling the tar and making pitch of it. I don't know but what we would run into just about as much trouble there as we would with disposing of the tar in the crude state. I guess if anybody attempted to create a market for pitch they would find the market invaded by others, and the price would drop suddenly. They would have the disposition of their creosote oil to take care of, and that is not an easy one. There is a demand for it; I guess not a very great demand. We have given up the manufacture of coal tar, and so solved the question in that way. We make water gas.

The President—There has been offered with special recommendation a new burner by the Connelly Iron Sponge and Governor Company for burning tar. I should assume from the description that it is quite elaborate. It was made for the North Adams Gas Light Company, and it was proposed to equip one or two of our upright Hazelton boilers, 250-horse power each, which operate the electric station. It contemplated taking out the grates and rendering the boiler absolutely useless for coal; also, they would have to have a certain fixed amount of tar, and it would necessarily have to be run 24 hours every day. That seemed impracticable to me. It seemed rather impossible for us to take out one of the six boilers, and the price apparently was prohibitive unless most excellent results were obtained. I wonder if any member here has any intimate knowledge of it, or has seen it operated. Is it known to be in operation anywhere among the members of this Association? The Parson's tar burner can be bought for a very few dollars. This Connelly system installed, which is quite complete, including the firebrick and the tile that are necessary, and the connections and piping, costs some $240. I have not seen it. From the description I should assume there was quite a detail connected with its installation. I ask for information, and perhaps it would be valuable to other members, if anyone knows of it.

Mr. Prichard—In connection with burning coal tar I am on record in a paper before the American Gas Light Association as to what may be done with tar as boiler fuel, and I have seen no reason to change the figures which I gave then. If I remember them correctly, with Cumberland coal, used under the boiler at $4 a ton, coal tar was worth about $1.35. We have burned a great deal of coal tar and a great deal of water gas tar in the boilers of the electric station. There is absolutely no trouble in burning either to get a perfect combustion. Almost any of the burners will do it properly. It is only a matter of regulating the flow of the tar. I imagine that in the Connelly device, from what little I have heard of it, more attention is paid to the feeding of the burner and the system as a whole than there is to the burner proper. It is called a burner, but it is rather a system than a burner. I wish someone could take up very carefully, as I tried to do in the paper on tar as boiler fuel, just what could be done with tar under benches. My point was to determine the fuel value as burned under boilers, which is quite a different problem from the tar burned under benches. In one case you want quantity of heat, and under benches you want intensity. I have no doubt that it is perfectly feasible and possible, if you have a market for your coke, to make tar worth anywhere from $1.75—well, I have heard people talk as high as $2.50 a barrel for coal tar. If such is the fact it seems a shame for our own people to go bearing the market by unloading tar anywhere from 75 cents to $1, when they have a field for its use right in their own works at a higher price without going outside. They are cutting their own throats and ours also. Both those fields are open and sure; the fuel value under a boiler and the fuel value under the benches. I have heard Mr. Africa give some very good figures the other day. I think it would be a very good idea if he would give them again.

Mr. Africa—I have not any very definite figures. We are using tar under 6 benches, and it varies from 90 gallons to 120 gallons per bench for 24 hours. Our coke is worth 11 cents a bushel. A bench will use from 54 to 60 bushels of coke in 24 hours Sixty bushels of coke at 11 cents would be worth $6.60. If a bench can be operated with 2 barrels of tar (about 100 gallons) the tar would be worth $3.30 a barrel. But we have only been operating a short time, and do not know how the results are going to last. I have not any question but what the tar will be worth at least $2.50 a barrel to burn under the benches. We have

an active demand for coke at 11 cents per bushel, so by selling the coke we would use under the benches and using tar instead, we in this way convert our tar into money.

The President—What burner do you use?

Mr. Africa—An ordinary burner that we made ourselves. We also have one of the New Haven burners in use. They work about alike.

Mr. Lamson—Do you use any coke with the tar?

Mr. Africa—We have used coke breeze. There is usually enough heat in the bench to ignite the burner in case it should go out temporarily. It has only been in operation practically since the 1st of February, so we have not any very definite figures.

The Secretary—What style of benches are used?

Mr. Africa—Three are plain settings and three half-depth; six benches in all.

The President—Which works the better, the plain setting or the half-depth; or is there any difference?

Mr. Africa—There is not much difference; a little in favor of the half-depth bench, because there is more room.

The President—I made reference to it in my address this morning, in view of the fact that we sell no coke but burn it all under the electric boilers. We are at the present time burning about 5 barrels a day with an ordinary burner that we made. Two of these boilers are equipped with 2 burners each, and they are run, say, from 4 o'clock until 10 in the evening with very excellent results. We credit the gas department with 3 cents a gallon, $1.50 a barrel, and it is good fuel. Of course, there is a solid bed of bituminous coal mixed with the coke, but we are thereby enabled to take care of the peak of the load without any inconvenience whatever, or without firing an extra boiler, due entirely in my opinion to the efficiency of the tar. Locally our problem for tar as well as coke is solved. We don't offer any coke for sale. I would like if our friends could make a bench that would stand tar consumption. Perhaps it may be possible. Everyone would have more coke for sale or for use, and burn all the tar. It is a very important question.

Mr. Sherman—This question was thoroughly threshed out in the annual meeting of this Association in 1900, in a paper read by Mr. B. J. Allen, Superintendent of the Allston works of the Brookline Gas Company. By referring to the published proceedings of that meeting, you will find cuts and description of the various tar burners experimented with and the results obtained. Mr. Allen is in attendance and can refresh our memories regarding his experiments.

The President—Mr. Allen, will you give us if possible such information as you have?

Mr. Allen—At that time we were burning tar under our fixing benches (the Wilkinson process). I tried a number of experiments, using dry steam and also with air. We used various kinds of tar burners. I experienced no trouble with a furnace large enough to give a good combustion, and using an ordinary tar burner, known as the New Haven burner, which is in the form of a T with a tar inlet at the side and steam at one end, which is a very good burner, very simple in construction and operation. We found it very satisfactory, excepting that we had to occasionally touch it up and clean out the small pipe running into the furnace. That style of burner has been used by other companies as far back as 1880, and I have always been able to get very good results with it. I think where the furnace is small the most satisfactory way would be to blow it in if possible with compressed air, which aids combustion. I don't think there is any trouble in burning tar in any ordinary bench, and I think with the plain setting or old-style bench you can get as good results in burning off the coal in retorts by burning tar as you can with a full-depth or half depth regenerative bench using coke as fuel. My experience with burning tar has been satisfactory.

The President—Are you using it now?

Mr. Allen—We are using water gas tar now under four through benches, merely maintaining a low heat.

The President—How many gallons?

Mr. Allen—We are using about 500 gallons of tar under four through benches—that would be 8 fires—maintaining merely a heat in case we are called upon to make gas. When we are making gas we burn a little more than a gallon per 1,000. If we were burning Texas fuel oil we would use about ½ of a gallon. I would just as soon have good water gas tar for fuel under our benches as I would Texas oil. That is our experience. But in burning coal gas tar you will use more tar, and it is a little harder to burn. It is not quite so inflammable and does not kindle so well. A deposit of carbon will form in the furnace in burning coal tar that you do not get so much of, if any, while burning water gas tar. But I think that a little coke breeze burning on the grate bars, just to keep the tar burning under the bench, and a New Haven burner, tar blown in with steam, is a very good way of burning tar, especially if the combustion chamber or furnace is large enough.

The Secretary—I should like to ask if anyone has developed a system, aside from the one referred to, for burning tar. I have for some consecutive hours been able to maintain a flame from the coal tar burner which seemed to be pretty nearly perfect, but, as one member expressed it, a "plug" of tar would come along and upset my adjustment, and everything had to be gone over. If some means could be devised for straining or bringing to some temperature or consistency the coal tar, so that it would flow with even, uniform supply to the burner, I think it would be very much simplified. I also think that the gentleman from New Haven could refer to the reports of this Society, wherein he gave some figures on the value of tar as fuel, which possibly when called upon he might be willing to bring to our minds again.

The President—Perhaps Mr. Sherman will remember those.

Mr. Sherman—I said at that time what is on record, and I will say it again. It is no use to give your tar away; it has a value for fuel purposes. We are independent of the tar distillers; they can take it or not at our price. That is, if they won't give what it is worth for fuel, we burn it. There is no trouble about burning it. We burned it for the last 10, 12 or 15 years in New Haven successfully. Mr. Allen's experiments confirmed by experience with that.

The President—Mr. McKay, what have you to say?

Mr. McKay—We have at one of the plants a boiler of the B. and W. type which we have fed with tar fuel, both water gas tar and coal tar, from which the grates are removed and into which the burners are fitted, so that they have a small retort outside of the boiler setting itself. In a measure it is an adaptation of the indirect fire system. There is a large combustion chamber and a great mass of brickwork laid up inside, so that the heat is stored in the brick, and any small fluctuation in the tar supply is cared for, the hot brick acting as a balance wheel. To prepare the tar for burning it passes through a steam jacketed heater, in the outlet of which a thermometer indicates the temperature. With proper regulation of the steam supply in the heater and a careful regulation of the temperature, there is very little trouble in burning either coal tar or water gas tar. The boiler is 260-horse power.

Mr. Barnum—I will ask Mr. McKay if there is any evidence of corroding or pitting on the boilers. Does the flame strike the shell, or is it kept away from the shell.

Mr. McKay—As I stated we remove the grates. The burners are then set on the floor level. That makes a very long distance from the point of combustion of the tar in the lower part of the furnace to the water tubes, so that combustion has been completed before the flame reaches the tubes. In the case of water gas tar (indicating the difference that Mr. Allen referred to) the flame is much longer, as it is a more inflammable tar. With coal tar the heat of combustion is concentrated and not distributed through so large a volume; but by preheating the tar to the right amount we have sometimes used a coal tar that was extremely difficult to move in any other way.

The President—About what temperatures would that show as it is fed into the burner?

Mr. McKay—Ordinarily not over 120°.

The President—There is a very simple appliance we have at home. A large 6-inch pipe through which a steam pipe runs, is supplied with a small burner. The tar is fed very hot, so we have no trouble there in burning the heavy coal gas tar.

Mr. Barnum—I should like to ask Mr. McKay what evaporative power he gets. How many pounds of water at 212° evaporated per pound or gallon of tar.

Mr. McKay—I cannot state from recollection the exact figures; they, however, all tend to reinforce Mr. Prichard's statement as to the excellence of tar fuel.

The President—I think it is safe to say it is far above a pound of coal.

Mr. McKay—Yes.

The President introduced Mr. H. A. Carpenter, of Pittsburgh, Pa., who read the following paper on

THE IMPORTANCE OF FIREBRICK MATERIALS TO THE MODERN RETORT HOUSE:

Scarcity of reliable labor and resulting high wages have, to an ever increasing degree, stimulated capital and mechanical development to reduce the necessity of manual labor to a minimum, as well as to ease the burdens of those employed. From gas engineers the retort house has claimed the most attention in this respect of recent years, modern installations having developed to a point of requiring an average of not more than one-third of the amount of labor of old-style, hand-operated plants.

The great increase of capital invested per unit of capacity in the case of these labor-saving retort houses, as compared with old style, has been a perplexing problem which has demanded the most exhaustive consideration of the engineers who have designed and the investors who have furnished the money to build such plants. Attempts have been made in every possible direction to increase the efficiency of these installations, and results of such attempts, abroad and at home, are sufficient to illustrate the attending dangers and possibilities.

I believe it is generally understood to-day that it does not pay to attempt to save, in the case of a coal gas plant, by cutting down the expense of any mechanical devices, especially coal and coke handling machinery. Some modern plants have been failures from the excessive cost and time lost in the maintenance of such machinery, while the most successful plants have high capital charges in this respect, but low cost of operation and maintenance.

To materially increase the ability of the retort benches to make gas is perhaps the most attractive plan to reduce capital invested per unit of capacity of the retort house. Much has been attempted in this direction, but the limit of endurance of the fire materials available has been the controlling point. In order to operate inclines or machine stoked horizontals to the best advantage the retorts must maintain their shape and alignment. More refractory fire material and stronger settings of retorts are required for the same service than in hand stoked retorts.

In the modern retort house of from 2 to 3 million cubic feet capacity in 24 hours, the cost of the fire material is about 10 per cent. of the total investment, including ground occupied. Assume that the cost of renewing settings amounts to 3 per cent. of total investment of house and requires benches to be out of gas making 90 days. Let us assume, for the sake of comparison, that the best work to-day amounts to 40 pounds of coal carbonized per effective lineal foot of retort (16 inches by 26 inches or smaller) every 4 hours, and at that rate the retorts have a life of 900 days. Now this size retort can easily accommodate a charge 50 per cent. greater, or 60 pounds per lineal foot, which at the same rate of working would take 6 hours to carbonize.

Let us consider in the case of retort houses which are operated to full capacity the year round, or in any house for its maximum make, what the effect will be if we are able to force the benches to carbonize the heavy charge of 60 pounds per lineal foot in 4 hours, thus increasing the capacity of the benches 50 per cent. Even though we assume that this forcing would reduce the life to one-half, or 450 days, on the basis of 10 per cent. per annum for interest and repairs, and, taking into account time required for resetting benches, as well as the fact that each retort in the latter case would make 25 per cent. less gas during its life than in the former, the cost of gas from these charges would be 16 per cent. less per unit of capacity than on the 40-pound, 4-hour, 900-day basis.

Consider that were it possible, by doubling the assumed cost of fire material in the retort house, to produce retorts and settings which would carbonize the 60-pound per foot, 4-hour charges, for 900 days, then the interest and maintenance charges would be 26⅔ per cent. less per unit of gas made than on the first assumption.

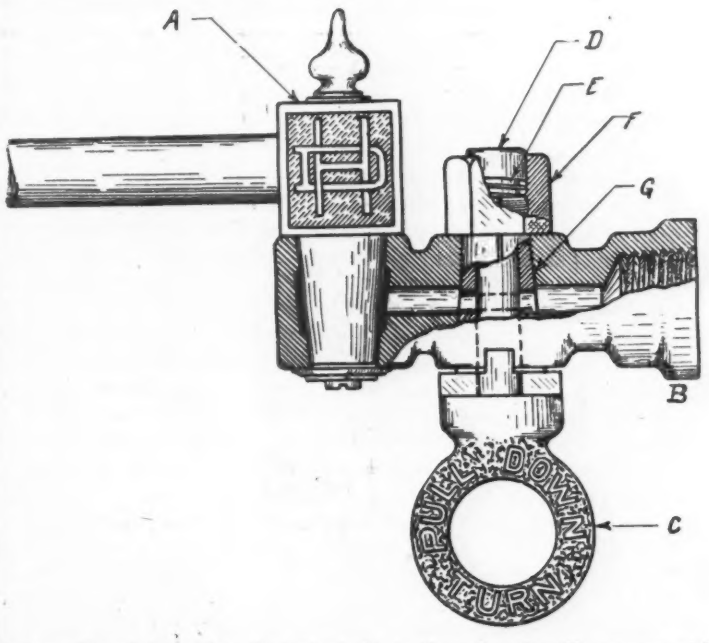
Other changes might be required to meet this additional increase in the capacity of the retort house, such as capacity of coal and coke machinery, gas off-takes, etc., but the added amount of capital from these items would be very small, compared to the great advantage of the foregoing assumption. Evidently we can afford to pay very much more for fire materials if by so doing the capacity of the retort benches can be materially increased.

(To be Continued.)

The Holt Safety Gas Cock.

Some weeks back we noted the fact that the Vanholden Manufacturing Company, of Providence, R. I., was putting on the market a patented gas cock, which seemed to us to possess features of real merit. Completing our then mention with this illustrated description, the usefulness of the device is put before our readers for their determining—the cut gives the actual size of the gas cock as arranged for a wall bracket, and is shown open.

D represents a straight cylindrical plug pierced with a hole for the passage of the gas when the cock is open. *E* is a spring which draws the plug *D* upward, thus bringing the hole out of line with the gas duct in the body of the cock. *G* is a split taper bushing which preserves a gas-tight fit on the plug *D* and in the body *B*. *C* is the thumbpiece of the fixture, which has a tongue to engage with the slot in the body *B*, when the cock is closed and the gas turned off, in this way providing absolutely against the gas being turned on accidentally, as the thumbpiece *C* must be pulled down against the pressure of the



spring *E* and turned so that the hole in the plug *D* will engage with the hole in the body *B* before the gas can flow. *A* is the regular gas bracket which is fitted in the regular manner to the cock. *B* is a regular gas cock body with the exception of the slot for engagement with the tongue of the thumbpiece. This is the only piece that would require to be changed for the different styles and sizes, thus insuring against any extra cost for the manufacture of the various styles. *F* is a nut which makes adjustment for wear by drawing the split taper bushing *G* into the taper hole of the body *B*, thereby forcing the walls of the bushing tightly against the straight plug *D*. This insures a tight fit always.

[Continued from Page 330.]

Indoor Humidity.

By Henry Mitchell Smith, M.D., Brooklyn, N. Y.

Moisture Capacity and Temperature.—Let us suppose that at a temperature of 40° F. the weight per cubic foot of the existing watery vapor be 70 per cent. of that required for saturation. We express this atmospheric condition as a "relative humidity of 70 per cent." If now the temperature falls below 40° and the amount of vapor remains the same, then the percentage of saturation will be higher than 70 per cent., since at a lower temperature less vapor is required for saturation. If the temperature becomes higher than 40° the relative humidity will be less than 70 per cent., because more vapor is required for saturation at the higher temperature.

This latter condition is exactly what occurs in every artificially heated room, unless an increased amount of watery vapor is produced by artificial means. Whatever be the percentage of saturation of the vapor that enters from out of doors, a lower relative humidity is created because of the higher room temperature, and the human body is exposed to the enormous moisture extracting properties of an atmosphere that is very dry—not because it contains less moisture, but because the existing vapor is so much further from the saturation point; for spontaneous evaporation is a constant phenomenon and is most rapid when the aqueous vapor is furthest from saturation.

The effect of different conditions of humidity is best shown by determining what the aqueous vapor lacks of saturation, for this measures not only its capacity but its demand for moisture. There is a factor for this called the "saturation deficit," which many meteorologists have proposed to substitute for the relative humidity in the psychrometric tables.

Comparison Shows Need of Moisture.—Let us compare in grains per cubic foot the saturation deficit of the average winter outdoor conditions with that of the artificially heated room. The mean relative humidity of New York city for the months of October to April, inclusive, is approximately 73 per cent., as has been seen. The mean average temperature for the same months is 44°. The tables give the following values for the absolute humidity in grains, from which we obtain the saturation deficit as follows:

Average Outdoor Conditions.

Average Temp.	Average Relative Humidity.	Average Absolute Humidity.
44°	73 per cent.	2.404 (grains per cu. ft.)
44°	100 " (saturation.)	3.294 " "
Saturation deficit = 3.294 — 2.404 =		0.890 " "

Average Indoor Conditions.

72°	30 per cent.	2.552 grains per cu. ft.	
77°	100 " (saturation)	8.508	" "
Saturation deficit = 8.508 — 2.552 =		5.956	" "

This shows that each cubic foot of aqueous vapor out of doors is 0.890 grains short of saturation, while each cubic foot of aqueous vapor indoors is 5.965 grains short of saturation.

The skin and the mucous membranes of the respiratory passages are the principal sufferers, since these tissues are always kept moist with their own secretions, and from them water is freely abstracted to satisfy this large saturation deficit, such air passing with every inspiration over the moistening surfaces nature has provided in the mucous membranes calling for an enormous output of the fluid elements of these tissues. This leads to glandular over-activity and its consequent evils, the elaboration of which subject the scope of this paper does not permit.

Diseases Due to Dryness.—The overheating of our houses has been accepted as a prominent cause of "catarrh," but I am confident that the low relative humidity and consequently the large saturation deficit of the aqueous vapor in the atmosphere of our rooms in winter is much more important than is the overheating in itself, and it may be doubted whether the so-called damp climate of the sea coast or the shores of large inland lakes is in itself so responsible for the above diseases as has been generally supposed. It seems much more likely that the great contrast between the indoor and the outdoor relative humidity in those regions is the real factor.

The temperature in itself is not the destructive agent.

Humidity of High Dry Cities.—It may be of special interest to compare the saturation deficit in artificially heated rooms with the average at Denver, Col., which is as follows:

Average Temperature. Degrees.	Average Relative Humidity. Per Cent.	Average. Absolute Humidity.
51	50 (approximately)	2.111 (grs. per cu. ft.)
51	100 (saturation)	4.222 (grs. per cu ft.)

Saturation deficit = 4.222 — 2.111 = 2.111 grs. per cu. ft.

The previous computation showed that in artificially heated rooms this was 5.956 grains, or more than twice as large as the average at Denver, Col., and nothing could express more graphically the dryness produced by artificial heating without artificial moistening. In addition to the excessive evaporation caused by such conditions the loss of body heat is greatly accelerated. If our rooms contained more moisture we could live more comfortably at a lower temperature. The overheating is required because of the low relative humidity.

The atmosphere of our planet retains heat almost wholly by virtue of the aqueous vapor. Tyndall stated that "the removal for a single summer night of the aqueous vapor from the atmosphere which covers England would be attended by the destruction of every plant that a freezing temperature would kill." The importance of aqueous vapor in the atmosphere is thus stated by Prof. Warren S. Johnston, who says: "It is a curious fact that it is only through the moisture in the air that it retains heat. Heat naturally radiates from all bodies that are warmer than their surroundings; if the air has little or no moisture in it the radiated heat goes right through it without warming it, but if it is moist it stops the radiated heat, and heat warms it. If it were not for the moisture in the air it would be too cold to live in. Humidity in the air is nature's great bed blanket for her children, without which they would all perish; so, likewise, moisture in the living room acts as clothing and helps to keep us warm."

Temperature a Poor Guide.—A moment's consideration therefore shows that the prevailing practice of depending upon the thermometer as the sole guide in the heating of buildings is not only inadequate and unscientific, but it is often misleading. It is not sufficient to know only the temperature if we desire either comfort or health, for the same temperature produces varying sensations of warmth or cold, depending upon the relative humidity at the time existing. It is unscientific and arbitrary to lay down a fixed temperature as a standard for living or sleeping rooms unless the relative humidity is indicated as well.

At New York and along the Atlantic Coast the prevailing winds during cold periods are usually from the north or northwest, having passed over a dry, frozen area, which has presented little opportunity for the air to take up moisture. At such times the temperature of the air indoors is allowed to become as high as 76 to 78° in order to feel comfortably warm. Records from steam heated apartments show that the relative humidity was sometimes as low as 25 per cent., with a temperature of 78°, during a period of very cool weather in January, 1902. The high temperature is necessitated by the chilling of the body by the increased evaporation, evaporation being essentially a cooling process.

Temperature and Humidity Should Correspond.—It is needless to say how unhygienic as well as uncomfortable is such a distortion of the proper relationship between temperature and relative humidity. By regulating the indoor relative humidity we could keep our room temperature much more nearly stationary, irrespective of the temperature outside. But no improvement in indoor atmospheric conditions can be expected until heating engineers and the people they serve realize that with the ever varying absolute humidity out of doors no system of heating can be made satisfactory if the indoor relative humidity is disregarded. Even thermostatic temperature control will not fill the requirement, for a constant temperature is constant in its effects only if accompanied by a constant relative humidity.

The winter of 1902 and 1903 was occupied in taking records and observations in which an experimental moistening apparatus was attached to a radiator. The mechanism was such that the control of temperature and of the moisture were independent, a most important point, and observations were made at different temperatures and with varying percentages of humidity.

These tests were most instructive. In the first place, it was observed that with a proper percentage of moisture 70° F. was uncomfortably hot, 68° F. warm and 65° comfortable. By proper percentage of moisture is meant one which is never below 50 per cent. or above 70 per cent.—average about 60 per cent. It was determined by repeated experiments that a temperature of from 65° to 68° and a relative humidity of 60 per cent. produced the most comfortable conditions, which were in marked contrast to a temperature of 72° F., with a relative humidity of 30 per cent. The former felt warm and balmy, the latter, notwithstanding the higher temperature, chilly and dry, and the slightest motion of the air suggested a search for the source of suspected drafts.

(To be Continued)

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. GEORGE H. TAYLER, Secretary and Treasurer of the Warren (O.) Gas Light Company, informs us that Mr. George Daugherty has been appointed Superintendent.

IN the standing advertisement of the General Gas Light Company, of Kalamazoo, Mich., as the same appeared in our issue for March 6th (p. 379), it is stated that in one city of 30,000 inhabitants, there are 16,000 Humphrey lamps in use. Just cut off the last cipher, and the truth will have been told. Even at that, the percentage showing is excellent.

MR. HOWARD W. STARR has been appointed Manager of the Mohawk Gas Company, of Schenectady, N. Y.

THE Mountain State Gas Stove Company, with headquarters at Moundsville, W. Va., has been incorporated by Messrs. V. C. Echols, N. G. McGlumphy, Frank Hubbs, O. F. Crow and Irwin Stewart.

AT the annual meeting of the Rome (N. Y.) Gas, Electric Light and Power Company, the Directors chosen were: Jas. T. Lynn, M. B. Daly, Jno. D. McMahon, T. H. Stryker, Edward Comstock, E. Saeger, A. L. Wilkinson, R. A. Field and F. K. Pelton.

THE proprietors of the Pleasantville (N. J.) Gas Company are planning to extend the main system to Somers Point and Absecon.

THE United States Circuit Court for the district, through Judge Bradford, has issued an order discharging Mr. Robert Pennington as Receiver for the New Castle (Del.) Gas Company. The Court complimented Mr. Pennington for his diligence and accuracy.

AT the annual meeting of the Nashville (Tenn.) Gas Company, the Directors elected were: D. S. Williams, B. F. Wilson, J. H. Fall, W. R. Cole, T. J. O'Keefe, Joseph H. Thompson and A. H. Robinson.

SUPERINTENDENT MORRIS, of the Bay City (Mich.) Gas Company, has completed the plans for placing a pipe under the river which will give to the residents of the west side a supply of gas. They have been clamoring for such service for a long time.

MR. HENRY M. SAGE has resigned the position of Secretary to the Cincinnati Gas and Electric Company, the resignation to become effective May 1st. Mr. Sage retires from the Company's service voluntarily, which he has served faithfully and well since 1870. In that

year he became attached to the Cincinnati Gas Light and Coke Company in a subordinate position, and steadily advanced in its favor until the culminating point was reached in his career through his election to the Secretaryship in 1882.

MR. F. E. HOLDEN has been elected President of the Woonsocket (R. I.) Gas Company, vice the late Mr. Edwin Aldrich.

AT the annual meeting of the Quebec (Can.) Gas Company, the retiring Directors were re-elected.

THE Gas and Electric Development Company, of Philadelphia, recently organized to buy and sell properties that cater to the public, reports the sale of the Downingtown (Pa.) Gas Company. The property was purchased by Mr. F. S. North, formerly connected with the Westchester Lighting Company, White Plains, N. Y. Mr. North is now in personal charge of the Downingtown plant, and that he will make a "good go" of it there is little doubt.

A CORRESPONDENT, writing under date of the 12th inst., says: "I have not read anything in the JOURNAL concerning the new gas plant which was built and placed in operation at El Reno, Okla., in 1904, by Messrs. Campbell, Wilson & Harvey. The facts connected therewith are as follows: Ground was broken for the construction of the plant, April 11, 1904, and the works were put in operation September 15th of the same year. The sendout for the first 15 days was at the rate of 750,000 cubic feet per month. In less than 6 months it has gone to something over 1,000,000 cubic feet per month. The city has a population of about 10,000, and the rate at which it grows is all in favor of those who are assisting in its development. The corporate title of the Company is that of the El Reno Gas and Mining Company, and its officers are: President, Milo D. Campbell, Coldwater, Mich.; Vice-President, C. A Wilson, Holly, Mich.; H. T. Harvey, Secretary and Treasurer, Battle Creek, Mich. The officers are the proprietors and sole owners of the Company."

THE new trade mark law, which was recently signed by the President, goes into effect the 1st prox. As might be supposed from the title, the law is designed to insure the rights of manufacturers and others to the exclusive use of their trade marks. With this object in view it provides severe penalties for the infringement of trade marks registered in the Patent Office in accordance with its provisions. The old trade mark provided for the registration in the Patent Office of only such trade marks as were used in commerce with foreign nations or Indian tribes. The new law extends registration to trade marks used in commerce between the States, and it is thus applicable to almost every trade mark in use in this country. The reasons why owners of trade marks should have them registered in the Patent Office under the new law, and other information thereon as well, may be obtained by writing to the JOURNAL'S patent attorney representative in Washington, Mr. Royal E. Burnham, 833 Bond Building, Washington, D. C.

THE following is the text of the Page resolution, adopted by the New York State Senate last Tuesday, respecting the proposed investigation of the gas and electric business as now carried on in New York city:

"*Whereas*, There is general and widespread complaint in the city of New York of the prices maintained by the gas and electric companies operating therein; and,

"*Whereas*, The Board of Estimate and Appropriation, in December, 1902, adopted a report declaring the prices of said companies for public lighting to be unreasonable and excessive, and that the interests of the said companies had been so combined as to eliminate competition, and rejected their bids for public lighting; and,

"*Whereas*, The same prices for electric lighting in all the boroughs except Manhattan and the Bronx, having been again bid for 1904, and the Commissioner of Water Supply, Gas and Electricity having, notwithstanding a report of the engineer of surface construction that said bills were exorbitant and should be rejected, entered into contracts with said companies for services between March, 1904, and March, 1905, at the prices named in said bids; and

"*Whereas*, An excessive price for lighting service in said city involves a great waste of city funds, and imposes a wrongful burden upon the taxpayers and inhabitants of the city,

"*Resolved* (if the Assembly concur), That a joint committee be appointed, consisting of three members of the Senate and four members of the Assembly, which committee shall, as speedily as may be, proceed to investigate and examine into the organization and operation of the gas and electric lighting companies; the reasonableness of the charges maintained by the gas and electric lighting companies operating in the city of New York for services rendered the city and its inhabitants, with reference to the cost of the service and the capital actually employed therein; the conditions under which the business of the companies is conducted, with reference to competition; the quality of the service the circumstances connected with the negotiation and execution of the city light contracts of 1904; and any other phase of the gas and electric lighting business as conducted in the city of New York deemed by the committee to be germane to the purpose of such investigation; that the committee report to the Legislature as soon as possible the result of their investigation, with such remedial measures as it may deem proper; further,

"*Resolved*, That the said committee be, and it hereby is, authorized and empowered to require and enforce the attendance of witnesses and the production of books and papers, to administer oaths and to employ counsel, stenographers, clerks and such other employees as may be necessary for the purpose of the investigation. And a sum not exceeding $25,000 is hereby appropriated out of any moneys in the treasury, not otherwise appropriated, for the purpose of said committee."

THE Brookly *Daily Eagle*, of recent date, is our authority for the statement that the South Shore Gas Company, Mr. George MacDonald, Manager, 558 Fifth avenue, New York, has been granted a franchise for the right to build a gas works and operate the same for the supply of gas to the residents of Freeport, L. I. The maximum selling rate is put at $1.40 per 1,000 cubic feet.

THE East Pennsboro (Pa.) Gas Company, to supply gas for lighting purposes only to the residents of East Pennsboro township, Cumberland county, Pa., has been chartered by Messrs. Frank P. Snodgrass, George Vanmann, A. A. Clark, John T. Brady, R. C. Brady and N. Hamilton, all residents of Harrisburg, Pa.

AT the annual meeting of the Towanda (Pa.) Gas Company the officers chosen were: Managers, O. L. Haverly, F. T. Page, E. L. Smith, N. N. Betts, R. A. Mercur and E. B. McKee; President, O. L. Haverly, Secretary, N. N. Betts; Treasurer and Superintendent, E. L. Smith.

AT the annual meeting of the shareholders in the Providence (R. I.) Gas Company (its 58th) the following Directors were elected: William Goddard, George W. R. Matteson, Newton D. Arnold, L. Edward Studley, Henry Pearce, John W. Ellis, Isaac C. Bates, Henry D. Sharpe, John R. Freeman. The President's report showed that 967,570,500 cubic feet of gas had been made during 1904, divided as follows: 262,330,000, first quarter; 210,681,000 cubic feet, second quarter; 217,996,000 cubic feet, third quarter, and 276,559,000, fourth quarter. This the report shows is a 1.50 per cent. decrease or 15,189,000 cubic feet less than was made in 1903, which was the largest year in the history of the Company, 982,761,000 cubic feet being made. This increase came because of the coal strike and the shortage of fuel and so the decrease was not unexpected. The improvements at the South Station on Public street were referred to, the Company now having a modern water gas plant in every particular. The two water gas sets are each capable of making 1,800,000 cubic feet in 24 hours. An oil storage tank has been built at the South Station for holding 160,000 gallons of gas oil in order to obviate delay or shortage caused by weather conditions, which would affect the transportation by the Standard Oil Company. The condensing plant at the North Station in connection with the coal gas plant has been completed. A storage holder is to be put on the two acres of land west of Allen's avenue at a cost of $300,000 on all accounts. The report says all of these improvements to the property and works, when they are completed and in operation, will result in systematizing the operation of manufacture with a decrease in the cost of making gas and the ultimate result of reducing the price of gas to the consumers. Reference was made in passing of the indictment against the Company for polluting the river with water gas refuse. Full investigation and examination were granted to the harbor commissioner of the works. No fault was found with coal gas refuse the report said. The new works at Sassasfras Point were spoken of in relation to the decision not to make further extension of the north end plant. The price of coal was less, while the oil and naphtha were higher, making the average cost of material less than 1903. These materials were used: Gas coal, 26,884 gross tons; Lehigh, 8,519 gross tons; steam coal, 1,159 gross tons; gas oil, 2,835,977 gallons; gas naphtha, 257,759 gallons; coke, 264,293 bushels. The following residuals were sold: Coke, 361,254 bushels; coal tar, 460,634 gallons; ammoniacal liquor, 1,416,465 gallons; 42,616 feet of gas main has been laid; 5,948 feet have been relaid. There is now about 301 miles of main pipe; 815 service were put in, and 84 were relaid or re-located; 32,152 meters were in use Jan. 1, 1905, an increase of 697 for the year.

The Market for Gas Securities.

The "blow" has blown, and the gas and electric lighting companies of New York city are to be investigated again as to prices, and as to what they have paid out on other accounts, to show why they are still able to do business in this "the land of beef and beer" to the up-State man. The text of the Page resolutions, which will be found in our item columns, certainly shows that enough scope has been given to the Committee, but it looks to us the job the gentlemen have on hand is of a magnitude sufficient to keep them from rendering a report until after the genuine fishing season has commenced in the Adirondacks, or even in the Mongaup Valley. However, it is up to the Committee, the members of which are Senators, Stephens (Chairman), Page and Grady; Assemblymen, Apgar, Agnew, Merritt and Palmer. We await the pleasure of their doing. Consolidated sold down to 206¼ to 207, the closing prices of to-day (Friday). Brooklyn Union is 206 to 212.

The outside market for gas shares is strong. Baltimore Consolidated is 86½ to 89; Cincinnati Gas and Electric is 108¾ bid, ex div.; Peoples, of Chicago, is 111½ bid, and Washington (D.C.) is still just below the 350 mark.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 Wall Street, New York City.

March 20.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	206¼	207
Central Union, Bonds, 5's.	3,000,000	1,000	108½	110
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Mutual	3,500,000	100	300	320
Municipal Bonds	750,000	..	..	..
New Amsterdam Gas Co.. Bonds, 5's	11,000,000	1,000	112	113½
New York & Richmond Gas Co. (Staten Island)	1,500,000	100	35	..
1st Mtg. Gold Bds. 5 p. ct.	1,000,000	..	..	..
Northern Union, Bonds, 5's.	1,250,000	1,000	104	106
New York and East River.. Bonds 1st 5's	3,500,000	1,000	112	114
" 1st Con. 5's	1,500,000	..	106½	108½
Standard	5,000,000	100	125	130
Preferred	5,000,000	100	145	155
Bonds, 1st Mortgage, 5's	1,500,000	1,000	116	117
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	206	212
" " Bonds (5's)	15 000,000	1,000	113	115
Bay State	50,000,000	50	¼	⅜
" ncome Bonds	2,000,000	1,000	..	75
Binghamton Gas Works..	450,000	100	28	30
" 1st Mtg.5's	500,000	1,000	93	96
Boston United Gas Co.— 1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	5	5¼
" " Bonds, 5's	5,250,000	1,000	66	68½
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas and Electric Co	22,500,000	100	108¾	109 x
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	97½	99
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,625,500	100	107½	109
Consumers, Toronto	,000,000	50	200	204
Consolidated, Baltimore	11,000,000	100	85½	89
Mortgage, 6's	3,500,000	..	..	118
Chesapeake, 1st 6's.	1,000,000	..	..	..
Equitable, 1st 6's.	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	119
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	89½	92
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	50
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	381,000	1,000	75	75¼
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg.5's	1,225,000	1,000	104½	105
Hartford	750,000	25	190	200

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DIVIDEND NOTICE.

OFFICE OF THE UNITED GAS IMPROVEMENT CO.,
N. W. CORNER BROAD AND ARCH STS.,
PHILADELPHIA, PA., Mar. 8, 1905.

The Directors have this day declared a quarterly dividend of 2 per cent. (one dollar per share), payable April 15th, 1905, to stockholders of record at the close of business, Mar. 31, 1905. Checks will be mailed.

1553-5 LEWIS LILLIE, Treasurer.

POSITION WANTED.

An American gas engineer, with technical education and wide experience in coal and water gas plants (six years in English gas works), desires engagement as engineer or manager of a gas works in this country or abroad Best of references from present employers and others, Address, "P.,"

1553-5 Care this Journal.

Position Wanted

By young man capable of assuming entire charge of either gas or electric plants or a combination plant. Can show experience in every department and furnish first-class references both as to ability and character from my present employers. Address, "C. S.,"

1552-4 Care this Journal.

Position Wanted.

A man 42 years of age, for 18 years secretary and superintendent of small works, output 20,000,000 cubic feet, desires a position with a gas company. Would like similar engagement, but is open for anything within his capacity. Location immaterial. Can furnish best of references.

Address, "CENTAUR"

1553-2 Care this Journal.

WANTED,
Position by a Water Gas Maker.

1554-1 Address, "A-1," care this Journal.

WANTED,
A Position as Superintendent.

Over 10 years' experience in construction, development, manufacturing and financial departments of gas companies.

1554-3 Address. "W. J.," care this Journal.

WANTED,
EXPERIENCED GAS METER REPAIRERS.

Piece work. Apply at shop, 426 East 91st street, New York City.

1554-1

WANTED,
Skilled Gas Meter Maker.

Apply to gas works, 6th street corner of Provost street, Jersey City, N. J.

1551-4

WANTED,
A Young Man who is a Hustler,

To sell gas ranges on commission. None but a thoroughly competent man considered. Address, stating terms,

MORRISTOWN GAS LIGHT COMPANY,
1554-tf Morristown, N. J.

GAS PLANTS WANTED.

A party desires to purchase small or medium sized gas plant, which can be developed, in a good town in the States of Indiana, Illinois, Michigan or Iowa.

1554-3 Address, "CAPITALIST," care this Journal.

WANTED,
A GAS PLANT

In a city of 15,000 or more. Address,

NATIONAL GAS & WATER COMPANY,
1546-3mos 184 LA SALLE ST., CHICAGO, ILLS.

WATER GAS SET WANTED.

Wanted, a water gas set; about 5 feet. Please reply at once, stating maker, age and condition. Address, "GASTON,"

1553-2 Care this Journal.

WANTED,
SECOND-HAND, No. 6 ROOT EXHAUSTER.

Must be in good order. State price. Address, "EXHAUSTER,"

1554-tf Care this Journal.

FOR SALE.
Two Hundred Barrels of Coal Tar

Apply to FIDELITY GAS COMPANY,
1554-1 15 Exchange Place, Jersey City, N. J.

FOR SALE,
One 10-Horse Power Otto Gas Engine, Tank and Batteries,

Latest style; used six months. Address, the

SARATOGA GAS, ELECTRIC LIGHT & POWER CO.,
1545-tf Saratoga Springs, N. Y.

GASHOLDER FOR SALE.

We have a 31,000 cubic foot holder (50 feet in diameter) for sale. Holder is in brick tank. Erected by Deily & Fowler.

KALAMAZOO GAS COMPANY,
1552-tf KALAMAZOO, MICH.

THE AMERICAN STANDARD COMPOSITION CO.

—) MANUFACTURES (—

HEAT PROOF AND DAMP PROOF PAINTS

For Structural Iron and Steel, Gas Apparatus, Underground Piping, Boiler Fronts, Stacks, etc.

Our Paints will not crack, peel or scale. Heat does not affect them. They are moisture proof.

They are the Paints that Don't Come Off!

We let you Try before you Buy. Send for samples and prices.

AMERICAN STANDARD COMPOSITION COMPANY,
1707, Wall Street Exchange Building, New York.

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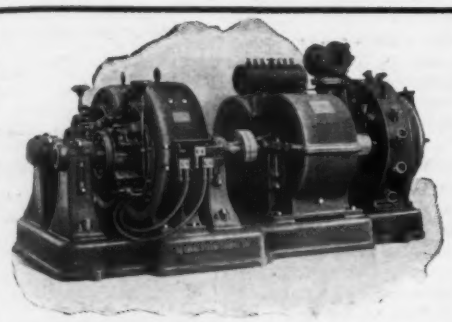
Utilize Your Gas Liquor.
NO EXTRA LABOR OR OPERATING EXPENSES.
IMPROVED AMMONIA CONCENTRATOR.
About 10 in use. Write to
STROH & OSIUS, Patentees, or
MICHIGAN AMMONIA WORKS, - Detroit, Mich.



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While conforming to the long accepted standard of design and construction for this type of meter, the most careful attention given to all the various details of construction by highly skilled and competent workmen, together with the use of the finest grades of material for the various parts, assures meters that are guaranteed to excel in the vital requirements of

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Made for Artificial, Acetylene or Natural Gas, with or without

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Ask for "TIN METER" Catalogue.

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THE CONSUMER AND THE MANUFACTURER OF GAS

join hands over the NEW INVERTED INCANDESCENT GAS LAMP---and shake to their mutual benefit.

The consumer has found a lamp of maximum effect and power at minimum cost. The gas man has found a better medium than the electric globe, and therefore a means of increased gas sales. Both are on a common footing again and on a fairer one than ever before.

THE NEW INVERTED INCANDESCENT GAS LAMP

adds a new power to gas, and a new light that excels electricity at but one-eighth the cost of maintenance---a light that is stronger, fuller and yet more mellow and soothing.

It is shadowless, and more pleasantly illuminates people and things about it.

It offers all the decorative effects that gave heretofore a preference to the electric globe.

It fits any fixture easily and securely.

It is the best, most economical and most convenient light.

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If not, write to-day for our special prices and discounts and information that will interest and aid you.

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Agent for the United States and Canada,

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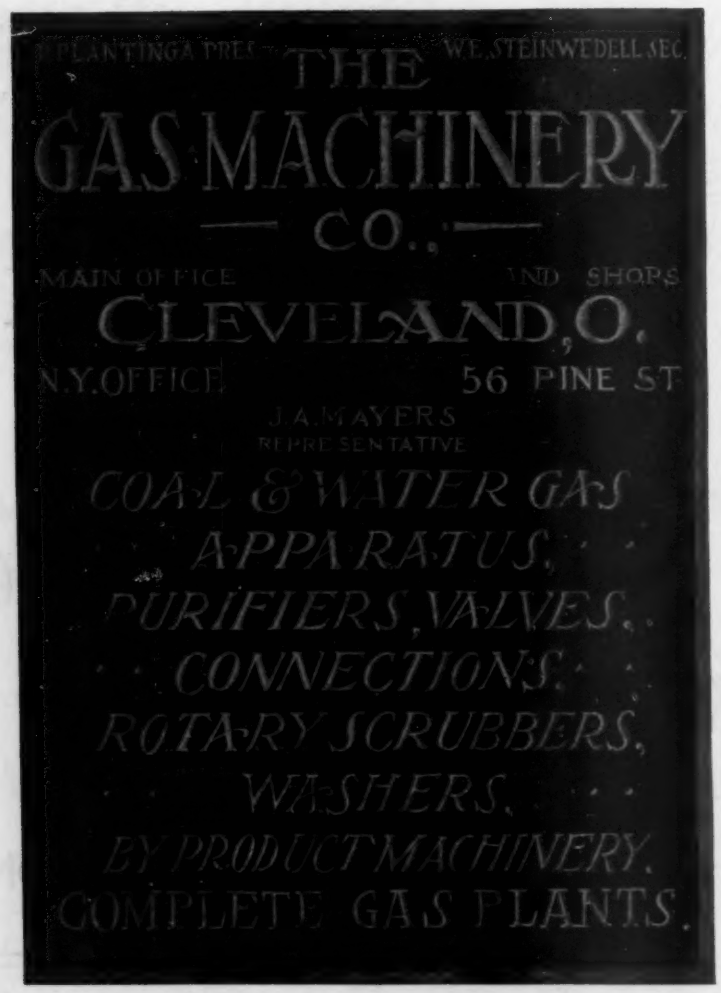

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Diameter, 12 "
Shipping weight, 80 lbs.
Net weight, 50 lbs.
The products of combustion are entirely separate from the water.
Entire water surfaces are tinned.

Price, $35.00.

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is most easily, quickly and economically supplied by a

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Prices range from $20 to $45.
Every Heater GUARANTEED.

Set a heater for every gas consumer. You will please them and increase sale of gas at the same time.

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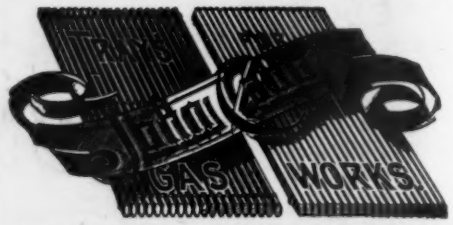
Reversible; Strongest; Most Easily Repaired.

Special Trays for Iron Sponge.



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Analyses of Solid and Liquid Materials as Well,

That are needed by Gas Companies at any time in the conduct of their business, may be obtained from

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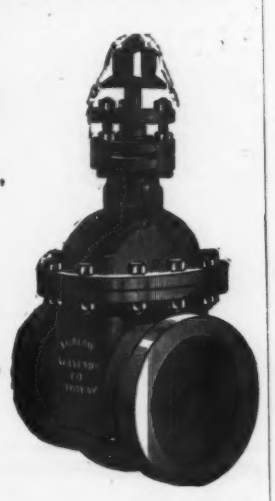

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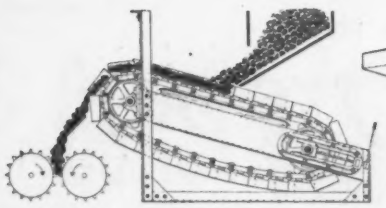

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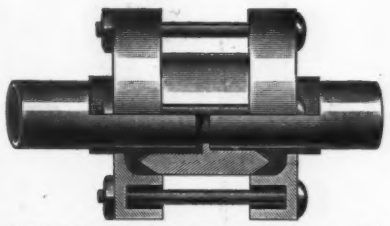

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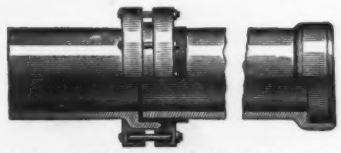

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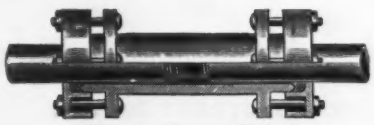

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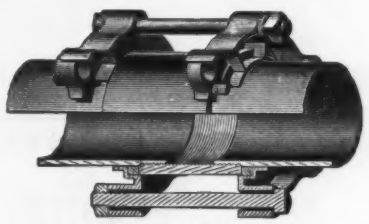

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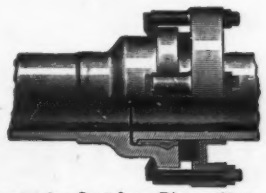

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Total daily capacity sold during January, 1905,

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DETROIT, MICH.

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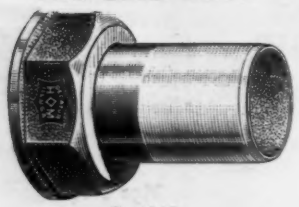
FOR LEAD PIPE.



C—1048.

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C—1049.

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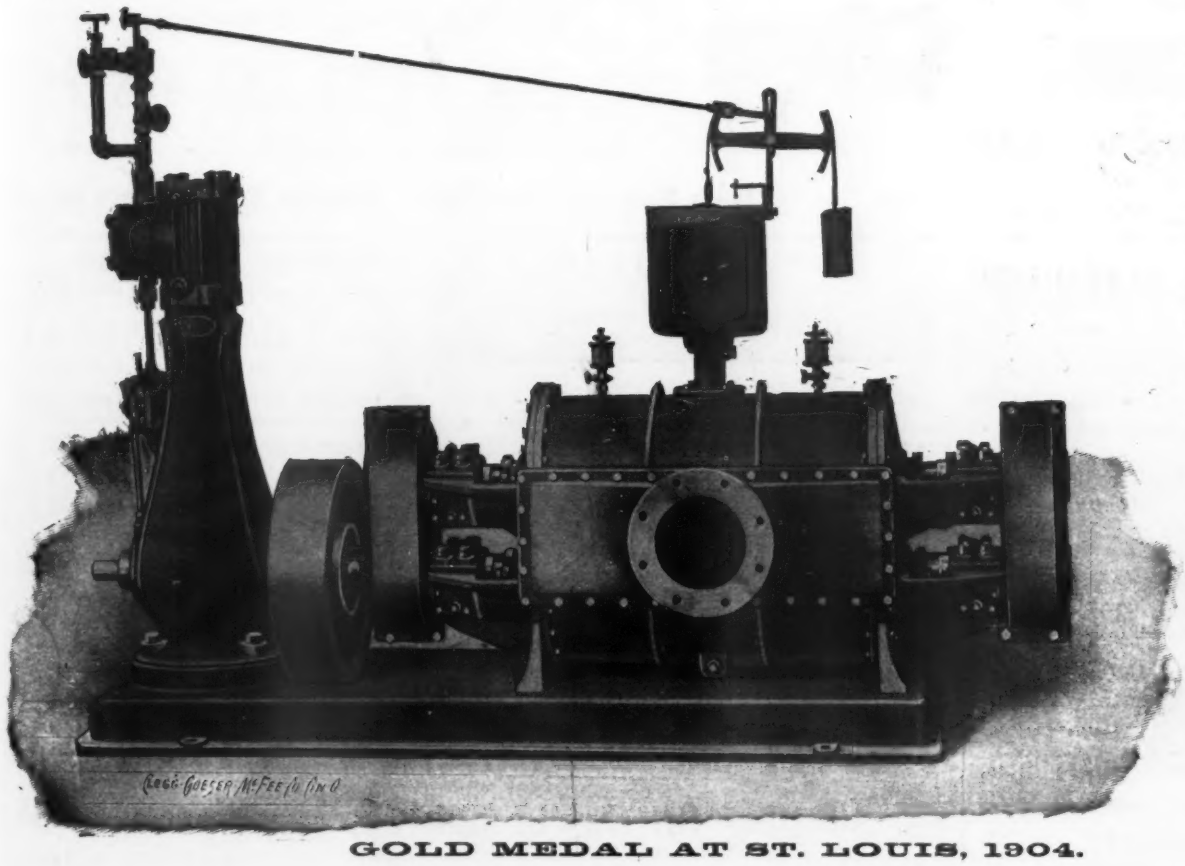

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Most perfect and sensitive Governor.

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USE YOUR OWN

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We can send you scores of testimonials from customers, but if you are not yet using our attachments we will send you a sample, free. Try it. If not the you have ever used, we will not expect your trade. :: :: :: :: :: :: **BEST**
Long warning to consumers, entirely preventing fatal accidents. Other important features.

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GAS TAPPING MACHINES

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Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

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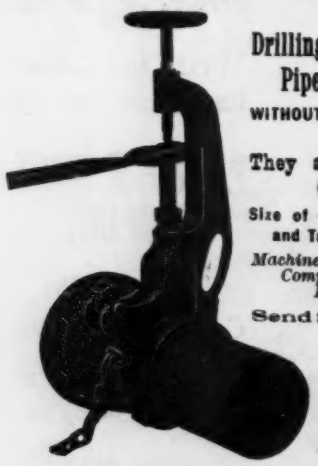

Geo. Light,
DAYTON, O.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION COMPANY, LIMITED,

Consulting Engineers.

Builders of UP-TO-DATE Machinery and Appliances for Coal and Water Gas Plants. :: :: :: :: ::

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SPECIFICATIONS
AND ESTIMATES
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May be consulted with reference to estimates of cost for new, or appraising actual value of existing works; utility of proposed or patented processes; relative earning power to capitalization, and management.

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CHEMICAL ENGINEER
—IN—
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P. O. BOX 2043. PHILADELPHIA, PA.

WARREN FOUNDRY AND MACHINE CO.,

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FROM THREE TO FORTY-EIGHT INCHES DIAMETER. ALSO, ALL SIZES OF

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

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CAST IRON PIPE and SPECIALS FOR WATER AND GAS.

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SAFETY GAS MAIN STOPPER COMPANY,

For Shutting Off Gas in Mains

Any size gas main can be shut off in 30 seconds. : : :

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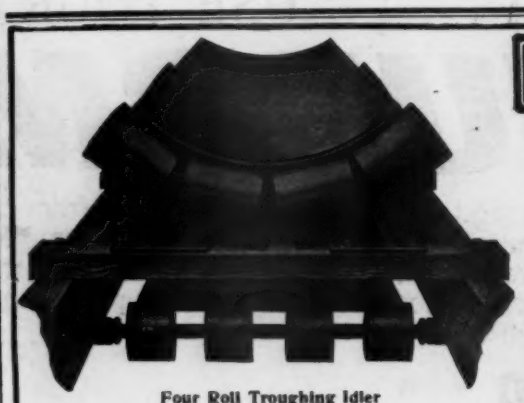
STATIONARY, SHAKING, DUMPING.

BARS FOR HAZELTON BOILERS.



Four Roll Troughing Idler
FOR WIDE BELTS.
The positions of the rolls conform to a natural and uniform curve of the belt.

BELT CONVEYORS

EQUIPPED WITH

BALL BEARING ROLLS

Possess greater efficiency, consume less power, and the belts last much longer than when any other type of roll is employed.

Permit us to tell you why and to submit plans and estimates.

The Link-Belt Machinery Co.
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AMERICAN METER CO.,

NEW YORK, ST. LOUIS, PHILADELPHIA, SAN FRANCISCO, CHICAGO,

Photometrical and Experimental Apparatus.

PUBLIC LIGHTING TABLE.

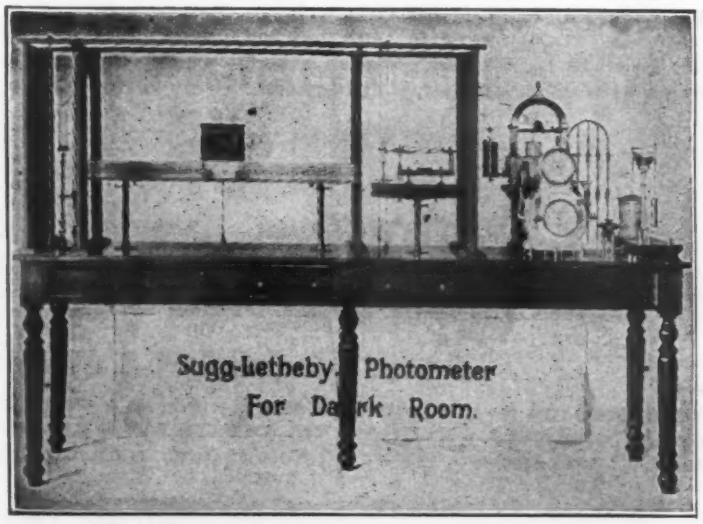
APRIL, 1905.

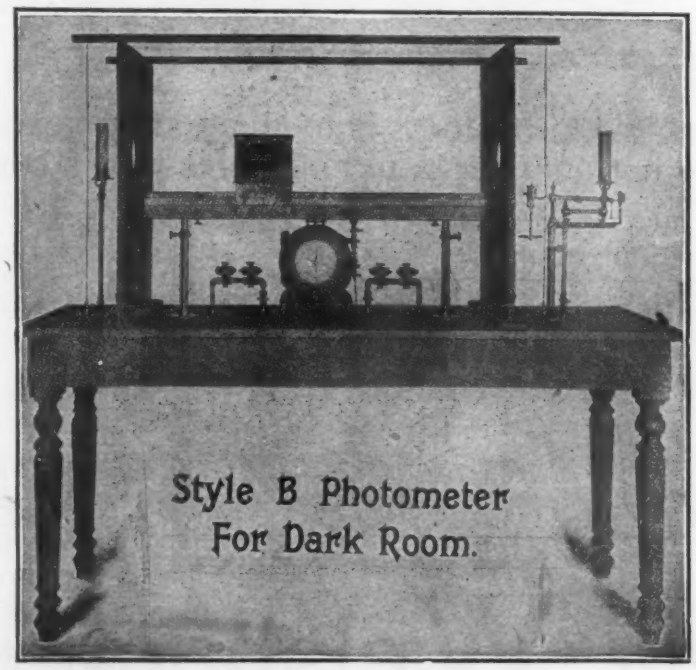
Day of Week.	Date.	Table No. 1. FOLLOWING THE MOON. Light.	Extinguish.
Sat.	1	6.50 PM	4.40 AM
Sun.	2	7.00	4.40
Mon.	3	7.00	4.40
Tue.	4	7.00 NM	4.40
Wed.	5	7.00	4.40
Thu.	6	7.00	4.40
Fri	7	7.00	4.40
Sat.	8	7.00	4.40
Sun	9	10.00	4.30
Mon.	10	10.50	4 30
Tue.	11	11 40	4.30
Wed.	12	12.30 AM FQ	4.30
Thu.	13	1.20	4.30
Fri.	14	2.00	4.30
Sat.	15	2.40	4.30
Sun.	16	3.20	4.20
Mon.	17	No L.	No L.
Tue.	18	No L. FM	No L.
Wed.	19	No L.	No L.
Thu.	20	7.10 PM	9.10 PM
Fri.	21	7.10	10.20
Sat.	22	7.10	11.30
Sun.	23	7.20	12.20 AM
Mon.	24	7.20	1.20
Tue.	25	7.20 LQ	2.00
Wed.	26	7.20	2.40
Thu.	27	7.20	3.20
Fri.	28	7.20	3.50
Sat.	29	7.20	4.00
Sun.	30	7.30	4.00

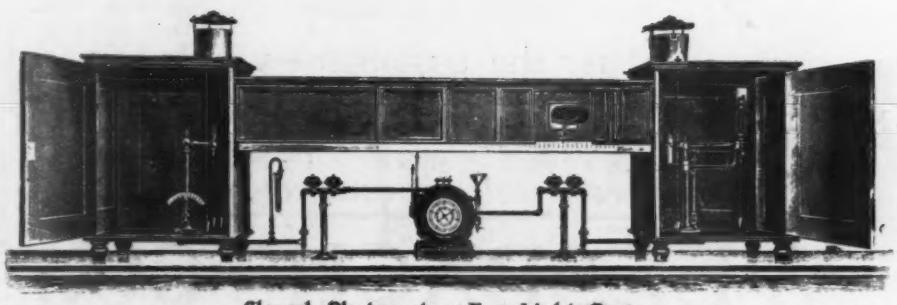
TOTAL HOURS DURING 1905.

By Table No. 1.

	Hrs.Min.
January	240.50
February	192.20
March	207.00
April	175.10
May	161.00
June	139.50
July	149.00
August	161.50
September	173.00
October	205.00
November	211.00
December	229.00
Total, yr.	2245.00







Closed Photometer For Light Room.

CIRCULARS SENT ON REQUEST.

PUBLIC LIGHTING TABLE.

APRIL, 1905.

Day of Week.	Date.	Table No. 2. NEW YORK CITY. All Night Lighting. Light	Extinguish.
		P. M.	A.M.
Sat.	1	6.10	4.55
Sun.	2	6.15	4.40
Mon.	3	6.15	4.40
Tue.	4	6.15	4.40
Wed.	5	6.15	4.40
Thu.	6	6.15	4.40
Fri.	7	6.15	4.49
Sat.	8	6.15	4.40
Sun.	9	6.25	4.30
Mon.	10	6.25	4.30
Tue.	11	6.25	4.30
Wed.	12	6.25	4.30
Thu.	13	6.25	4.30
Fri.	14	6.25	4.30
Sat.	15	6.25	4.30
Sun.	16	6.30	4.20
Mon.	17	6.30	4.20
Tue.	18	6.30	4.20
Wed.	19	6.30	4.20
Thu.	20	6.30	4.20
Fri.	21	6.30	4.20
Sat.	22	6.30	4.20
Sun.	23	6.40	4.10
Mon.	24	6.40	4.10
Tue.	25	6.40	4.10
Wed.	26	6.40	4.10
Thu.	27	6 40	4.10
Fri.	28	6 40	4.10
Sat.	29	6.40	4.10
Sun.	30	6.45	4 00

TOTAL HOURS DURING 1905.

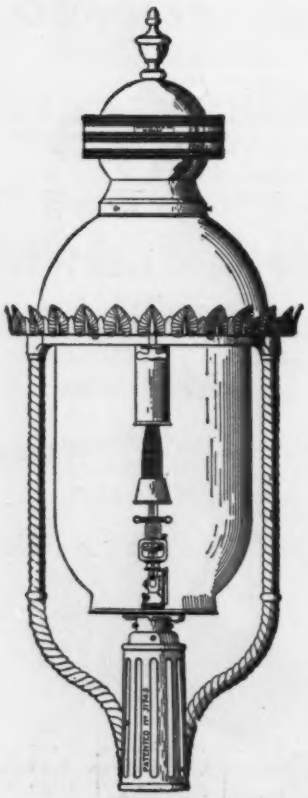
By Table No. 2.

	Hrs.Min.
January	423.20
February	355.25
March	355.35
April	298.50
May	264.50
June	234.25
July	243.45
August	280.25
September	321.15
October	374.30
November	401.40
December	433.45
Total, yr.	3987.45

NEW YORK, 9 Liberty Street. BOSTON, 814 Beacon Building. PHILADELPHIA, Broad and Arch Streets. ST. LOUIS, 712 Roe Building. CHICAGO, Foot of Orleans Street. SAN FRANCISCO, 712 Polk Street.

WELSBACH STREET LIGHTING COMPANY

.... OF AMERICA ....



No. 36.

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Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in 150 Cities and Towns.

By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.

Correspondence Solicited from Gas Companies and Others interested in Municipal and Outside Lighting.

No. 38.

AN underlying principle in business is to show an increase each year---to grow. The astute dealer not only seeks to retain this year's customers, but to attract new trade next year.

The formula is simple---

THIS SHIELD IS THE WELSBACH TRADE MARK.

IT IS A GUARANTEE AND A PROTECTION.

Sell The Welsbach Brands.

The imitation stuff is bad for the customer---which is bad for you.

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And your profit isn't merely dollars and cents.

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Pelham, N. Y.
Reading, Pa.
Augusta, Me.
Bangor, Pa.
Woonsocket, R. I. (2d contract).
Brooklyn, N. Y. (4th contract).
Cincinnati, O. (2d contract).
Scranton, Pa. (3d contract).
New York City (14th contract).
New Haven, Conn. (2d contract).
Watertown, N. Y.
Tampa, Fla. (3d contract).
Westchester, N. Y. (3d contract).
Bridgeport, Conn. (2d contract.)
St. Paul, Minn. (2d contract).
Springfield, Mass. (2d contract).
Lynn, Mass. (5th contract).
Rochester, N. Y.
Battle Creek, Mich.
Mechanicsburg, Pa.
Excelsior Springs, Mo.
Bristol, Conn.
Jersey Shore, Pa.
Vicksburg, Miss.

TOTAL SETS, 1904, ... 45
TOTAL DAILY CAPACITY, 1904, ... 56,325,000 cubic feet.
TOTAL SETS TO DATE, ... 553
TOTAL DAILY CAPACITY, ... 419,180,000 cubic feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia

Established 1858. Incorporated 1890.
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Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

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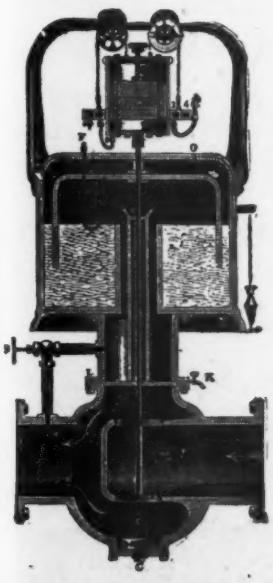

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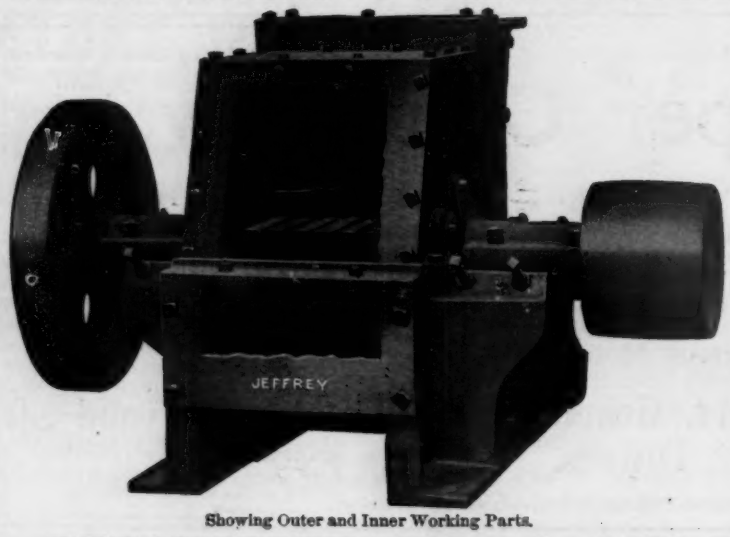

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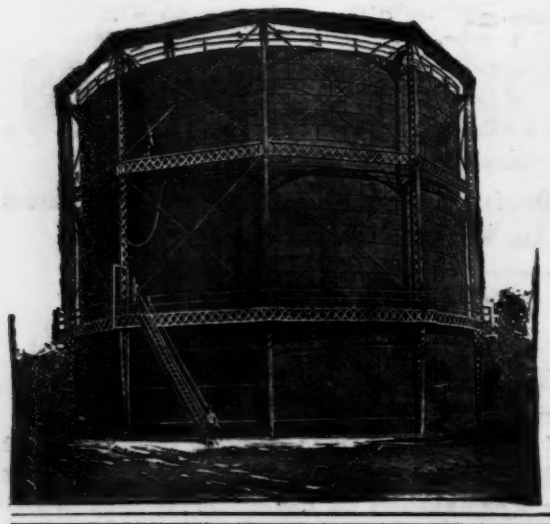

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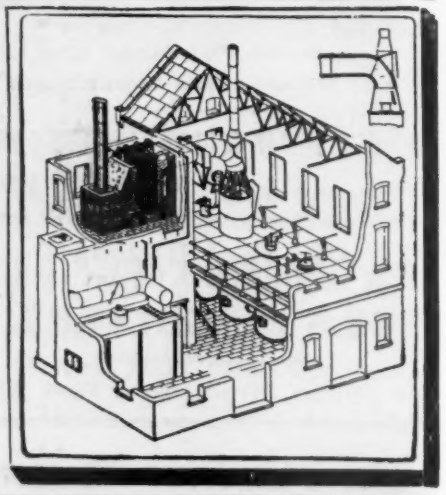

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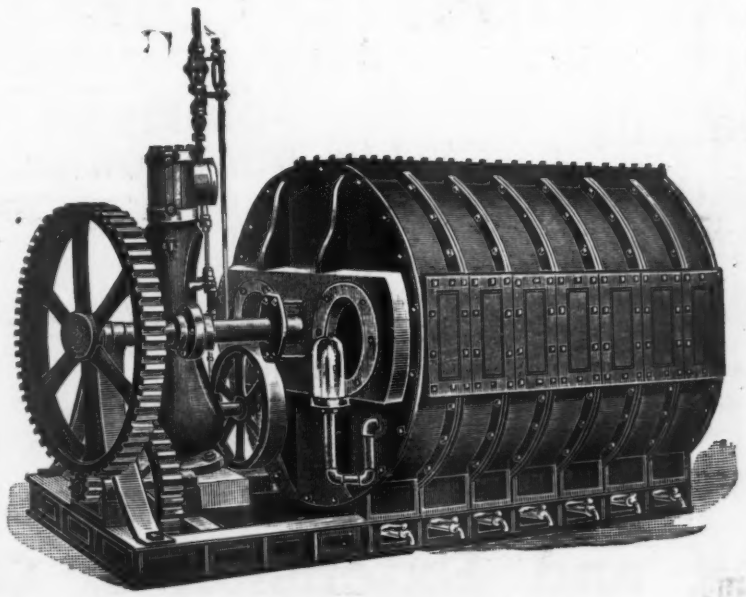

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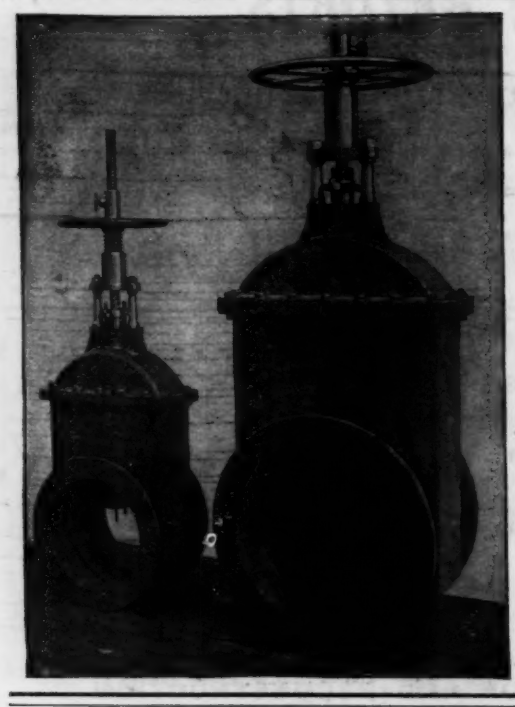

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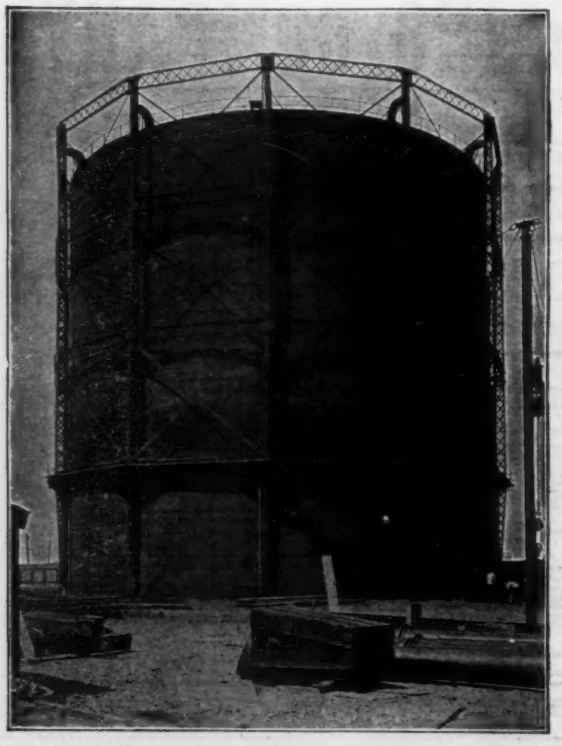

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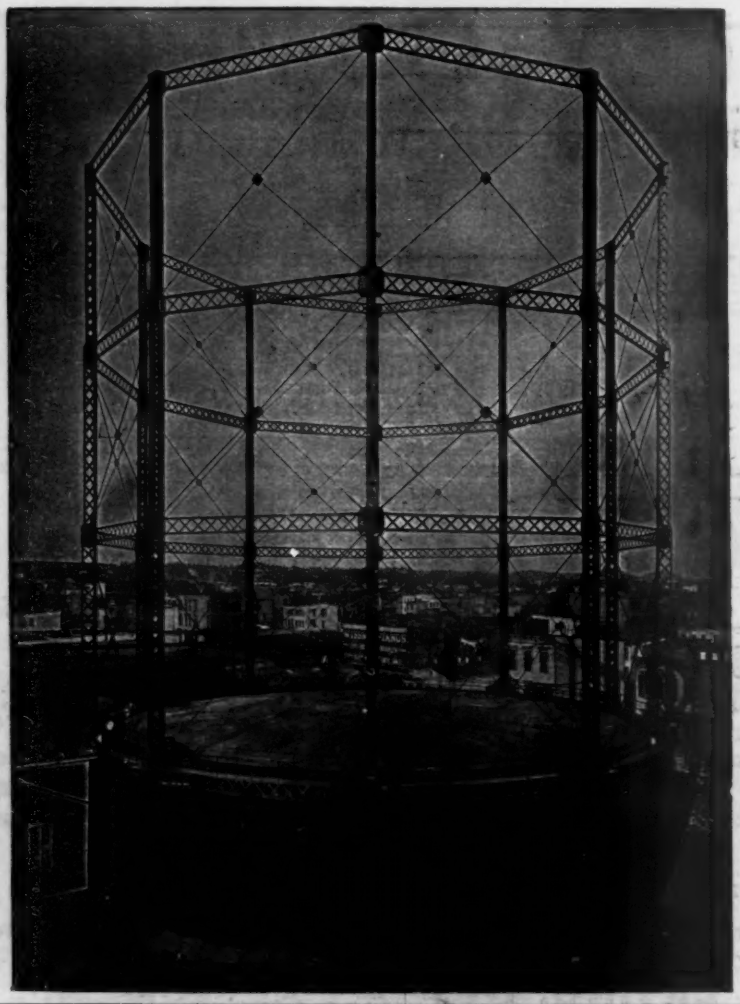

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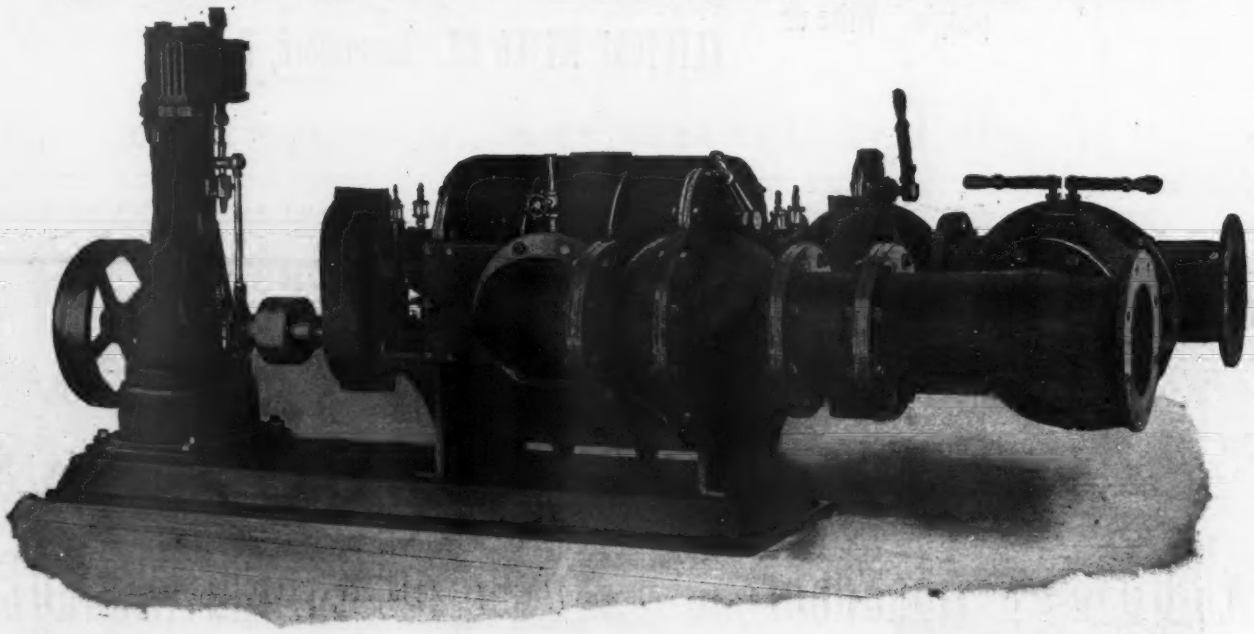

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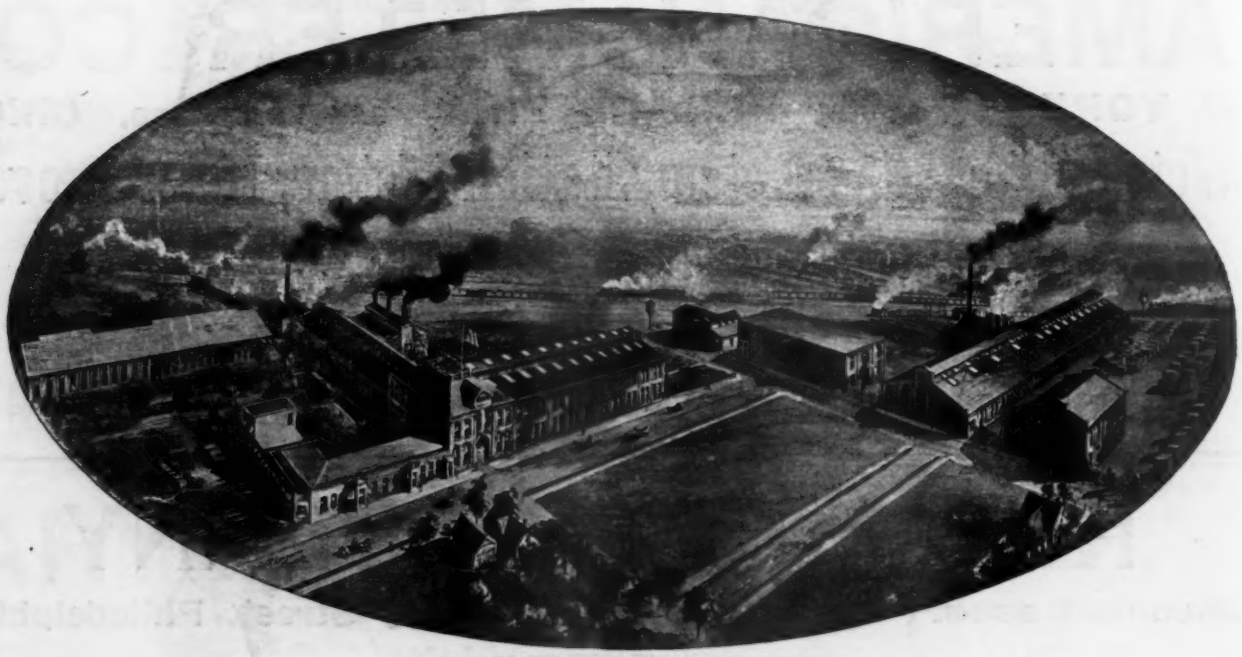

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